Author:
Thomas, Lisa May M

Title:
Investigating the Somatic Body in Virtual Reality

Exposing and Exploring the Perception Gap Between Seeing and Feeling in Participatory Performance

Author:
Thomas, Lisa May M

Title:
Investigating the Somatic Body in Virtual Reality:

Exposing and Exploring the Perception Gap Between Seeing and Feeling in Participatory Performance

Investigating the Somatic Body in Virtual Reality: Exposing and Exploring the Perception Gap Between Seeing and Feeling in Participatory Performance

Lisa May Thomas

A dissertation submitted to the University of Bristol in accordance with the requirements for award of the degree of PhD in the Faculty of Arts
School of Arts, July 2021

Word count: 68,489

Abstract

As a dance practitioner who works extensively with somatic and improvisation practices, my experience of entering into a virtual environment (VE) using virtual reality technologies (VR) brings about a tension between my moving, sensing body and the visual pull of the virtual environment – a *perception gap* between seeing and feeling. This experience and sensation, my response to the technology, has formed the basis of this practice-as-research project which delves into the complexity of the virtuality and corporeality of bodies and environments using a multi-person VR framework. The project methodology combines somatic-dance practices with participation in VR to investigate experiences of expanded perception through re-calibrating sensory awareness. Specifically, this research opens up possibilities for activating synaesthetic and expanded modes of perception which challenge normative, visually dominant sensory modalities. Chapter One lays out and discusses critical fields of theory and practice as a contextual framing for the research. Chapter Two frames and discusses two sets of workshops and their emergent themes*: Ways of Seeing* workshops at the *Bodily Undoing* symposium at Bath Spa University with somatic-dance practitioners (2017), and *The Felt Sense* workshops at Knowle West Media Centre with public participants (2018). The third and final chapter details and critically frames the participatory performances of *Figuring* (2018) and *Soma* (2019) which, building on the workshops, embed and craft somatic-dance practices as part of a three-part model for participation with multi-person VR. The design and sequencing of *Figuring* and *Soma* participant journeys are discussed, alongside critical issues of care, agency and touch, activated and considered through a dancerly lens. The thesis concludes in offering recommendations for further research across the fields of dance/performance, HCI, psychology and the social sciences.

Dedications

This research is dedicated to my children, Poppy Richardson and Miles Richardson, and to their futures, our future. You have been the inspiration that has led me to undertake this work, in the seamless way in which you reach and move into and across your imaginations, technologies and the material world around you. Your unbounded play transcends superficial boundaries and opens up possibilities for being and for being together.

This is also for my family, your never-ending support and love, without whom this research would not have been possible – Paul Richardson, Jean Thomas, Jane Richardson, Peter Richardson and Sara Gribble.

Acknowledgements

I would like, first and foremostly, to acknowledge and to thank my primary supervisor Professor Simon Jones, who has supported me through the thick and thin of this research. Your guidance and advice have been truly invaluable to me and will never be forgotten.

I would also like to acknowledge the other supervisors who have been with me in parts of this research journey: Dr Kate Elswit, Dr Angela Piccini, and Dr David Glowacki.

I thank the friends and colleagues with whom I have had critical and creative conversations over these research years, and I name just a few here: Libby Charlton, Verity Macintosh, Tom Morris, Tom Mitchell, Rob Arbon, and David McGoran.

And to past teachers, who remain very present in my practice: Janis Claxton, Peter Glenn, Chris Gladwell, Kirstie Simson, Lucia Walker, and Dr Nita Little.

This work was made collaboratively, and the details for all those who contributed to the project are to be found in Appendix 1.

Thanks also to Nina Ross for your help with editing the video documentation for this research.

Lastly, I would like to acknowledge the following publishers who have assisted me with my research by publishing earlier versions of content from Chapter Two:
Taylor & Francis, International Journal of Performance Arts and Digital Media, Volume 14 – Issue 2 (2018) *Seeing and Feeling in VR: bodily perception in the gaps between layered realities*, Lisa May Thomas, David R. Glowacki
https://www.tandfonline.com/doi/abs/10.1080/14794713.2018.1499387
Peer reviewed article for arXivLabs, Cornell University (2019)
Somatic Practices for Understanding Real, Imagined, and Virtual Realities, Lisa May Thomas, Helen M. Deeks, Alex J. Jones, Oussama Metatla, David R. Glowacki
https://arxiv.org/abs/1901.03536

Authors Declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's *Regulations and Code of Practice for Research Degree Programmes* and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

SIGNED: 
DATE: 7th July 2021

Table of Contents

List of Illustrations

Chapter 1

Part One

Introducing my Practice and this Practice-as-Research Project

In this research, I bring highly tuned attentional skills and sensory sensibilities into an engagement with Virtual Reality technology (VR). I am a dance practitioner whose work is underpinned by somatic principles and improvisation techniques. These practices inform my training, choreography and performance work. I have worked for many years to develop a particular state of presence, the ability to be tuned into and communicate through a field of sensations, of "metastable configurations between the microcellular, the multicellular, and the inter-corporeal" (Manning 2007: xv-xvi), within and beyond the skin boundaries of my body. I move and am moved by the human and non-human bodies and environments that circulate around and within me, their liveness and liveliness experienced through the dance-based tuning processes that are foundational to my practice. These tuning processes increase "felt and perceptual experiences of our own bodies" (Sheets-Johnston 2009: 337), the ability to sense the moving body as a dynamic force and fluid materiality, "a corporeal-kinetic intentionality, as bodily-kinetic experience" (Sheets-Johnston 2009: 337). Arising from these processes are different possibilities for questioning and re-building "emotional attitudes toward our bodies and to conceptual understandings of bodies in general" (Sheets-Johnston 2009: 337). My body, and the many dance bodies engaged in these practices, including those involved in this research, are post-human bodies, opened to "a body-thinking that exceeds the realm of the national body-politic" (Manning 2007: xxiii) and, in the potential of this extension, these bodies "engage creatively with what a body can do" (Manning 2007: xxiii).

Sensory processes are a touchstone in the dance practices that I engage in, activating and re-tuning the senses toward an integrated and synaesthetic play in perceiving the body and its relations toward other bodies and the surrounding environment. De-centring the visual sense, in its dominant position in the sensory system and as the driver of the senses, is a method used by dancers to support a synaesthetic modality for sensing. This is achieved through processes of visual deprivation, such as moving with the eyes closed, with a blindfold on or in dark environments. These processes pivot the senses away from a visual reliance, re-enlivening the non-visual senses and generating their more active participation in perception.

After a time, this sensory shift can be retained with the eyes open, re-integrated with incoming visual information. Nita Little is a dance scholar who practices and teaches dancers a mode of sensing that she refers to as tactile attention: "[w]hen we enhance our visual sense with its synesthetic potentials, sight combines with the tactile properties of our felt embodiment" (Little 2016: 97). Working in this way, as I do in my own practice, there can be a restoring of the "flow between the haptic and the optical that our culture is currently lacking" (Marks 2002: xiii).

I am interested in using these sensory training methods, which, as choreographer and dance scholar Susan Leigh Foster writes, "pivot[s] both mind and body into a new apprehension of relationalities" (Leigh Foster 2003: 7) and which have formed a substantial part of my own training in performance work. I have set out to this sensory re-tuning as a tool for devising and to offer experiences in which participants are actively sensorially engaged, in which their "consciousness expands out of passive reception of an event and toward active engagement in the actual making of the event" (Leigh Foster 2003: 9). I have created immersive experiences through the participatory workshops and performances of the practices of this research which follow and realise this interest. These are experiences in which, as Josephine Machon writes, "a quality of perception is activated and felt, affecting both perception and cognition in the immediate moment" (Machon 2013: 203) and which can "both offer insight to and be an extension of normal perception" (Machon 2013: 203). The (syn)aesthetic "performance style (encompassing the artistic process), and the audience receptive experience" (Machon 2001: 1) of Josephine Machon, scholar in contemporary performance, has influenced my thinking in the development and framing of my practice. Machon, alongside many of the thinkers and practitioners I use to critically frame this research, is informed by phenomenology, drawing in part on Merleau-Ponty's work. She writes that "all humans are synaesthetic but only a handful of people are consciously aware of the holistic nature of perception" (Machon 2013: 203). Machon articulates the ways in which immersive practice can "act as a trigger to activate or relocate this fused perceptual awareness" (Machon 2013: 203), as a "supernormal integration of synaesthesia" (Machon 2013: 203).

> Synaesthetic perception is the rule, and we are unaware of it only because scientific knowledge shifts the centre of gravity of experience, so that we have unlearned how to see, hear, and generally speaking, feel, in order to deduce, from our bodily

> organisation and the world as the physicist conceives it, what we are to see, hear and feel. (Merleau-Ponty 1962: 229)

My practice in this research begins with my own bodily experience and moves into the experiences of others – the research participants – in processes of interrogating the layers of presence and absence and the liveness and liveliness of human and non-human forms and materialities across physical and virtual domains. Attending to the sensorial aspects of their experiences, the participants in the practices of this research were invited to shift their visual centre of gravity toward a felt sensing, to form an awareness, to be open, "to the process of being aware of this shifting" (Machon 2013: 201).

Immersion into a VE using VR can lead to a sense of presence, of being there in that VE (Slater 2009). This illusion of presence in a VE relies on the sensory system being led by vision (Biocca 1997). Visual technologies, such as VR, enhance the way in which the senses are objectified and compartmentalised by science, prioritising visual data and reducing the importance or value of other sensory input. For dancers like myself, who have re-tuned their senses using synaesthetic processes, entering into a VE can bring into play the immediate effect of a perceptual tension between the visual, virtual environment and the physical felt environment. On entering into a VE, I experience a tension, a discomfort, between my moving, sensing body and the visual pull of the simulated world. This is a phenomenon that I term and refer to in this writing as a *perception gap* between seeing and feeling. I have discussed how dancing bodies move attending to a field of sensation which is felt and tactile, and this mode of sensing is at odds in a VE that is reliant on visual information to drive the senses. In this research, I aim to intervene in - the VR technologists' ambition to make continuous - the flow of reality through the visual world presented by the VE and disrupt it with a somatic liveliness and synaesthetic perception. I bring to VR an embodied knowing which contradicts or is at odds with the ways in which the technologies of VR are designed, placing visual input as the driver of an experience. In this research, I call for a livelier bodily and sensorial awareness and activation in the spaces of VR, using dance-somatic and improvisation practices to challenge the normative vision-centric use of the technology. Technologists and artists engaging with VR typically find ways to cover over the perception gap*,* to create a reality that is fluidly and synchronously experienced by the participant. In contrast, I seek to expose the perception gap, to sustain its opening, to move and play within

and across it and, through this practice, to "question the stability and 'natural' order" (Jones 2006: 21) and "arrangement" (Jones 2006: 21) of the senses.

Caroline Jones, professor of art history at MIT, argues that "commodity culture will continue to put its faith in the instrumentality of vision" (Jones 2006: 21) and that it is key to find ways to "relinquish the visual ordination of intellectual knowledge" (Jones 2006: 21). This research pushes back against and challenges the human modes of engagement with technologies that serve to further this visual ordination. Dance practices and embodied knowledge offer pathways into sensing the body, other bodies and the environment, which background the visual and bring to the fore a felt and relational presence of the human and non-human world. These synaesthetic processes offer up a different experience; "the perceived world begins to shift and transform" (Abram 1997: 63). Phenomenologist David Abram writes about these processes of sensory transformation, through which "[c]ertain phenomenon that have habitually commanded our focus begin to lose their distinctive fascination and to slip toward the background, whilst hitherto unnoticed or overlooked presences begin to stand forth from the periphery and to engage our awareness" (Abram 1997: 63).

Using somatic and improvisation practices in dance as a methodology, I interrogate the perception gap between seeing and feeling using VR technology, investigating the complexities and capturing the experiences of this perceptual tension and the expanded sensations of sight and touch that occur across the layering of physical and virtual domains. I explore my own sensory habituations and perceptual patterns, and those of the participants, in an engagement with the technology. VR technological pioneer, Jaron Lanier, considers VR to be "one of the scientific, philosophical, and technological frontiers of our era" (Lanier 2017: 1) and the "farthest-reaching apparatus for researching what a human being is in terms of cognition and perception" (Lanier 2017: 1). In this research, VR is encountered as a way in which to have a dialogue with the body and with the senses, rather than an experience which overrides them, and so that "[a]s VR progresses in the future, human perception will be nurtured by it and will learn to find ever more depth in physical reality" (Lanier 2017: 50).

Laying out the Research Questions

The central research questions which underpin the practice and writing of this research begin with my own experience, on entering VR, of the perception gap between seeing and feeling. I

come to VR technology as a dancer; this research is based on my bodily and sensorial encounter with it and what this encounter has subsequently revealed to me. This research is not initiated on premeditated theoretical or philosophical questions concerning the technology, or with regard to perception or perceptual gaps as a kind of philosophical and physiological reality in a more generalised way. This research has been initiated from an actuality, an experiential moment in time – my own troubling encounter with the technology, from which moment I have endeavoured to 'stay with the trouble' (Haraway 2016). VR technology exposes all kinds of perceptual gaps and qualities in our perception that the 'everyday' is not able to offer. By bringing a dance sensibility into an encounter with the technology, all kinds of issues to do with the senses of sight and touch and the ethics of the experience arise. This is because of the shock and the perceptual confusion that resonates in the assembling of a moving, sensing – somatically and sensorially aware – body with the technology.

The specific perception gap referred to in this research is taken from my personal experience with VR, combining the technology with my dancerly sensibilities. It pertains to the gap between the visual environment seen within the headset and the felt, somatically sensed body and environment my body is attuned to through training and practice. The issue of this perception gap is somewhat ignored by technologists, attended to as a problem with the system – a technical fault or suchlike. It is an issue stepped over or covered up with the desire to achieve the complete transference of reality to a three-dimensional simulated world that immersive technologies are designed to enable. My dance perspective deals directly and unapologetically with the experience of this perceptual disturbance as a focal point for engaging with the technology. I do this by inviting a practice of attending to the senses, and noticing the immediate disturbance, whilst putting on a VR headset and entering a VE. In doing this, I want to raise awareness and understanding of the confusion and tension that exists on first entering into VR - as not just a glitch that will pass, but something fundamental to the experience of the technology. To not pretend that this shock to the senses does not exist, as this will have future consequences, but to dive deeply into the sensations that emerge from it. Grounded in my own encounter with the technology, the practice of this research follows my fascination with this very specific and technical problem of the perception gap. A problem that opens up the creative, collaborative, philosophical, and practical issues and questions which underpin this research and which I lay out below.

i) What is the perception gap between seeing and feeling in the context of bringing together dancer sensibilities and VR technology, and what are the experiences that arise through an expanded sensing within and across the perception gap?

This question opens up a need to understand how it might be possible to trigger or activate the perception gap in someone's attentional field, whether and how this might require a different approach for different people, and why.

ii) Is the perception gap experienced differently by different people, and why is this?

In my research, I combine dance practices with VR technology to activate experiences of the perception gap as the use of the senses in these practices are in direct tension with the visual VE. I am interested in finding ways to use this approach to create shared participatory experiences and performances and how these modes of engagement with the technology can reveal further questions.

iii) How can shared participatory practices – workshops and performances which combine somatic-dance and improvisation tools and tuning processes with multi-person, interactive VR technology – challenge dominant sensory patterns, using the idea of the perception gap, and open up synaesthetic and expanded modes of perception and embodiment that can be shared and experienced with others?

In these participatory practices, there can also be an awareness of the process of this sensory shifting. This can offer a more flexible and responsive bodily and sensory engagement with technology, which leads to the following question:

iv) Can an awareness of the activation and shift in the senses, in an encounter with VR which provides a heightened experience of the perception gap, be practised to offer a greater level of flexibility and agency in the senses, and thus in modes of perception and embodiment?

Lastly, ethical considerations which have emerged through my practice with VR have become a key aspect of my thinking and practice in working with the participants using the technology, and this leads me to consider a final question.

v) What are the ethical practices needed for participation in VR, and how can dance-based thinking and practice respond to these needs?

Ethical practices have been considered across two domains: firstly, in a practical, instrumental capacity, undertaking an ethics review focuses on how the research is conducted with people, ensuring that safety is a prime concern with the apparatus of the technology; and secondly, with more conceptual, ethical concerns which arise in bringing people together (collaborators, dancers and participants) in immersive settings. Rigorous ethics procedures, using University of Bristol protocols, were followed for this research project. It is important to note that: all participation was voluntary; participants were informed that they could withdraw at any time, without needing to give a reason; alongside the consent form, an information sheet was made available, which detailed the research activity, and I was available to respond to any questions the participants had on reading and signing these forms. Participants were also able to select, via an additional media consent form, different levels of permission for the (audio, video and photographic) documentation, and the use of their data and right to remain anonymous was made explicit. More conceptual ethical concerns have been considered, firstly, through the lens of dance-somatic and improvisation practices – drawing on the writing and practices of Nita Little, Nancy Stark Smith and other practitioners in the field of Contact Improvisation, its highly nuanced relational practices of partnering, movement improvisation and touch; through Josephine Machon's work in the genre of participatory and immersive performance, and Steve Benford and Gabriella Giannachi on Mixed Reality Performance (MRP); touching on the social ethics of participatory art (Claire Bishop, Grant Kester); and, lastly, drawing from the VR/technology industry and the use of immersive technology such as VR for immersive artistic/gaming 'installations' or 'interactive demos', taking into account the specific affordances of VR, its participatory conventions and the current ethical concerns in the field (Madary and Metzinger, Cortese and Zeller).

In this chapter, I lay the contextual ground and theoretically outline the framework for the interrogation of these research questions, which take place through practice outlined and critically framed across chapters Two and Three. This chapter is in two parts; in the first part, ideas, philosophies and practices of body-technology relations are discussed. This starts with a critical history of VR technology which outlines its specific technological affordances and use of applications and leads into a discussion of artistic practices which engage with and aestheticize technologies such as VR. This section brings up philosophical issues and ideas

surrounding the body in participatory and sensory relations with technology, and I discuss these in relation to my own thinking and practice and the key ideas that are central to this research. Following this, I draw on the field of Human-Computer-Interaction (HCI) and its recent turn to the body and to the somatic, comparing notions of the body as a user of technology in HCI to the sensory bodies of dancers like myself who use somatic practices for training and choreographic processes. I discuss how thinking in HCI both resonates with and opposes my own thinking and practice and the basis of the questioning for this research project. The second part of this chapter offers a broader theoretical grounding for the research, bringing in the thinking and philosophies of key and critical thinkers to aid my own questioning in terms of the ways in which human engagement in technology leads to particular modes of sensing, moving and interaction and, subsequently, to the ways in which modes of perception and embodiment are constructed or organised. This section leads into a more detailed outline of my project as a whole, and on the layout of chapters Two and Three. These next two chapters detail and critically frame how the participatory practice of this research operates across a developmental series of workshop and performance practices, constituting four practical elements – two workshops and two performances which combine somatic, sensory and improvisation practices and VR, and which investigate the different experiences of participants.

Why Virtual Reality?

VR is an emerging and immersive technological medium "in which subjects use a head-mounted display (HMD) to create the feeling of being within a virtual environment" (Madary and Metzinger 2016: 2) (also referred to as a VR headset and both terms are used interchangeably in this writing). The term virtual reality is used to refer to a wide range of technologies which range from simple 360-degree camera systems to fully immersive, interactive, simulated virtual environments. I will also adopt the term virtual environment (VE) to describe the virtual world into which the participant enters using VR technologies, drawing on Fisher's notion to specify the virtual environment rather than a virtual reality, so as to locate or situate it rather than present it as another version of reality (Fisher 1982, 1986, 1991). VR sits within the paradigm of extended reality (XR), which refers to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables (cited in Wikipedia 2020), i.e. augmented reality (AR), mixed reality (MR) and virtual reality (VR). Each of these technological media offers distinct

experiential qualities and affordances. Whilst technologies such as AR and MR layer digital/virtual information (e.g. environments/bodies/objects) over/onto physical environments/bodies/objects or are placed (as objects, screens, or worn as digital items) within acknowledged/seen physical environments, VR, distinctly, replaces the visual environment completely. Researchers, Michael Madary and Thomas K. Metzinger working across the philosophy of mind and the ethics of emerging technology, remark that "[u]nlike other forms of media, VR can create a situation in which the user's entire environment is determined by the creators of the virtual world" (Madary and Metzinger 2016: 5). VR sits at one end of the Reality-Virtuality Continuum (see Figure 1) as designed by Milgram and colleagues (1995), the levels of virtuality on this spectrum ranging from partially sensory inputs on one end to immersive virtuality on the other. VR technology "necessitates absolute inclusion within a 360-degree digital environment, the user metaphorically stepping inside the computer" (Dixon 2007: 365) and introduces "dramatic new ways of disrupting our relationship to the natural world" (Madary and Metzinger 2016: 2). Going beyond offering a participant an extension into new perceptual domains, VR offers a complete transference into a new perceptual reality. This technology, as Madary and Metzinger assert, evokes the very real possibility of an eventual redefining of not only "our general image of humanity but also our understanding of deeply entrenched notions such as conscious experience, selfhood, authentic life, or realness" (Madary and Metzinger 2016: 2). This research uses a dance-based methodology to investigate the experiences of bodies in VEs using VR technologies, specifically exploring the sensory ramifications on dance-based modes of sensing, moving, interaction and communication the technology affords.

Figure 1: reality-virtuality continuum introduced by Paul Milgram, 1995

In his famous essay, *The Ultimate Display* (1965), Sutherland proposed a "technology to immerse people in computer-generated worlds" (Slater and Usoh 1994: 1) and laid out much of the groundwork for modern VR as it is today.

> We live in a physical world whose properties we have come to know well through long familiarity. We sense an involvement with this physical world which gives us the

> ability to predict its properties well. For example, we can predict where objects will fall, how well-known shapes look from other angles, and how much force is required to push objects against friction …A [VR] display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland. (Sutherland 1965: 1)

Sutherland realized his ideas in 1968, presenting "a user with a stereoscopic 3-dimensional view slaved to a sensing device tracking the user's head movements" (Slater and Usoh 1994: 1) – the HMD or VR headset. The tracking sensors on the headset meant that a user could look through the optical display within the headset, and the movements of their head, looking left to right and up and down in that VE, would correlate with what they were seeing. Computer scientist Mel Slater, who has undertaken extensive research into presence, immersion and embodiment in VR, outlines that immersion in a VE can lead to a sense of presence, of being there in that VE. He writes that the degree of immersion is dependent on "the extent to which a VR system can support natural sensorimotor contingencies for perception" (Slater 2018: 432). A system that supports "being able to perceive using the whole body (bending down to look underneath something, reaching out, looking around an object, etc.) would be at a higher level of immersion than one that just afforded looking at a screen (for as soon as you turn your head away from the screen you are no longer perceiving the virtual world)" (Slater 2018: 432). Though the basic design of an HMD has broadly remained the same, Sutherland's model has been updated over the decades. Since the late 1980s, "[t]he advance of computer graphics knowledge and technology, itself tied to the enormous increase in processing power and decrease in cost, together with the development of relatively efficient and unobtrusive sensing devices" (Slater and Usoh 1994: 1) has led to a resurgence of interest and increased market demand (the second wave of VR).

The term VR is used to describe a wide range of experiences and technologies, from linear VR - 360-degree environments in which the user or participant has little agency to move around or interact, to fully interactive VR, which offers the participant the ability to move and to interact within the VE, "the human participates in the virtual world rather than *uses* it" (emphasis added) (Slater and Sanchez-Vives 2016: 3). Lanier writes about this interactive agency within a VE, of becoming present in that VE as "not just an observer, but a native" (Lanier 2017: xii), remarking that, without this interactivity and agency, you are "a subordinate ghost that cannot even haunt" (Lanier 2017: 129). In my writing, I replace the

term ‘user’ with ‘participant’ as, in the practices of this research, those involved are actively engaged with and within interactive VR frameworks. I invite the participants of this research into experiences with VR that open up and investigate their participatory agency through opening their awareness of the layering of the physical and VEs that co-preside and guide a crossing between them. In one moment, the participants experience the technology in felt, material form, touching, feeling and holding the weight of the headset and controllers and, in another moment, they experience its mediating effect, seeing and being seen, moving and interacting, affecting and being affected within its (virtual) environment.

The sense of presence, of being there in a VE, is led by the bodily senses:

> The body is our connection with reality, it is the means through which we participate in everyday reality. Our sensory organs take in data about external reality, which leads to perception, cognition and eventually to behaviour which converts this information into meaningful action through which we change external reality. (Slater and Usoh 1994: 3)

Encountering VR technology, the perceptual system perceives the VE “and the brain-body system automatically and rapidly reacts, while the cognitive system relatively slowly catches up” (Slater, 2018; 432), at which point the “reactions have already occurred” (Slater 2018: 432), the brain is “fooled into the illusion of being in an alternative world” (Slater and Usoh 1994: 4). Professor in performance and new media, Gabriella Giannachi, citing Tice and Jacobson (1992), defines VR as “technologies or environments that provide realistic cues to some or all of the senses, sufficient enough to engender in the participant a willing suspension of disbelief” (Giannachi 2004: 9). This notion of the technology is apparent in the many VR experiences that are developed, but it is a notion that is challenged in bringing a dance practice to the technology in this research. A practice that collides with the illusion and which creates an experience of the VE existing in relation to, not instead of, the physical world otherwise left behind. In Giannachi’s writing on *Virtual Theatres*, the participant “has to be put into a situation where they experience the virtual environment as becoming present. Thus, virtual reality has to be able to double the viewer’s sense of location and experience, and accent it” (Giannachi 2004: 123). My research seeks to open the participant’s awareness of this accenting, or emphasising, of the VE and of the visual and, through this awareness, to shift the emphasis toward the felt as an alternative mode for sensing whilst in the VE.

The VE seen from within an HMD generates its simulated properties towards the participant's senses. This is achieved predominantly through the visual display, although this can often be accompanied by associated auditory, tactile and kinaesthetic displays –which are also typically driven by or rely on the visual information of the VE. VR is "primarily centred around vision" (Slater and Sanchez-Vives 2016: 4) and whilst it may have sound and some elements of haptic feedback, "vision alone is often enough for numerous applications, since anyway for many people, it is perceptually dominant" (Slater and Sanchez-Vives 2016: 4). Humans have developed sophisticated perceptual abilities to be able to integrate different sensory information from the world around them into a smooth and continuous experience of reality. All of the body's "sense perceptions are the ultimate foundation of our knowledge about ourselves and the world" (Slater and Usoh 1994: 3). It is vision that leads the senses in perception, and it is this sensory trait that VR uses to suspend disbelief in its participant. Though, it is important to point out, spatialised audio is increasingly being used in VR as a tool for immersion and, specifically, to direct the gaze within a VE. VR offers its visual world to the participant, and her brain rallies to fill in the gaps, to push away or suppress any sensory input that does not align with it. Harnessing the power of the visual system as the driver of the senses, VR is able to change the participant's perception of reality, "[e]verything about you and your world can change" (Lanier 2017: 55). For example, "participants in a VR typically encounter a situation where their visual system places them on, say, a roller coaster, but all other sense perceptions are from the surrounding physical environment. Nevertheless, they may scream and react as if they are on the roller coaster even while talking to a friend in reality standing nearby" (Slater and Sanchez-Vives 2016: 4). The body in a VE is receiving sensory data simultaneously from two different environments – from the VE and from the physical environment. The VE becomes foregrounded in the experience; the physical environment drops into the background. This is due to the dominance of vision in the senses.

The embodied awareness that a dancer, trained in somatic and improvisation practices which foreground a synaesthetic mode of sensing in place of one that is visually dominant, brings to VR causes a problem for the designed illusion of the VE. This research project, therefore, takes this tension between the felt and synaesthetic sensing of a dancer, and the dominant visuality of the VE requiring visually dominant sensing in VR, to further unpack the experience of the perception gap. I explore the relationship between these different modes of sensing and the perception and embodiment of participants inhabiting a VE. The reliance on

vision is a typical human sensory trait, and this trait is re-enforced through VR (and other vision-based technologies). This research brings processes of somatic sensing and somatic tools to invite a noticing of the ways in which the technology shifts, pulls and shapes 'reality' away from the 'soma' and toward the 'image'.

The emergence of a visual presence of the body in a VE was initiated through the work of "VR industrial pioneer" (Dixon 2007: 365) Jaron Lanier (founder of VPL Research in 1984) in the development of his DataGlove (1984), which allowed him to use his hand in a VE. Lanier went on to develop the DataSuit (1989) "so that people would be able to drive avatars with their whole body" (Lanier 2017: 139). This is an area of particular interest, and also complexity, for this research, which resonates in a body-based practice in exploring the relationship between the virtual seen and physical felt experiences of bodies across virtual and physical environments.

"Watching a film or playing a non-immersive video game cannot create the strong illusion of owning and controlling a body that is not your own" (Madary and Metzinger 2016: 2) – while VR technology brings the participant closer to this sense of embodied agency, visual immersion within a 360-degree simulated environment, with a virtual avatar moving in close correlation to the movements of their own physical body, is one step further to being there. By bringing in the other senses to align with the visual sense, for example, using audio and haptic technologies, there is a further step. With the occupancy of a virtual avatar and this move toward the VE, there has to be a move away from, or a reduction of, the participant's awareness of their physical body and its presence within the physical environment.

Slater argues that the sense of presence within the VE is increased through the visual presence of avatars, or virtual bodies; the illusion of "being embodied in a virtual body, in a body which is 'other' to one's actual physical body" (Madary and Metzinger 2016: 2). The VR headset blocks out all the visual information of the physical environment, yet, as Slater writes, the body's "proprioceptive stream is informing us, as always during the conscious state, that the body is still there as usual" (Slater and Usoh 1994: 4). This somatically oriented sensing of the body offers a felt feedback mechanism to the participant through a bodily movement that tallies with the movement of the body within the VE (often centred around the movement of the eyes and head, and hands). Whilst the participant is still

connected to their physical body via this proprioceptive stream, sensing their body kinaesthetically, the visual feedback produced by the avatar is driving the experience.

In the practices of this research, somatically sensing bodies are placed into encounters with VR, investigating the body as both seen and unseen within the VE and the stream of sensory information, which both tallies with and is in discordance with the VE. Lanier's experience of the DataGlove – the simple act of "using my hand inside VR" (Lanier 2017: xii) and the ability to reach out and touch the VE – "changed not only how virtual reality felt to me, but how physical reality felt" (Lanier 2017: xiii). Having this embodied agency in the VE "revealed [his] physicality in fresh light" (Lanier 2017: xiii). Lanier's experience chimes with the sensibilities of this research, which unpacks this co-existence of bodies and their environments across digital and corporeal domains. I investigate how different facets of these bodies and environments are hidden from a VR experience and find ways to reveal or expose them.

Shared and Social VEs

Alongside the developments of the DataGlove and the DataSuit, the use of which participants could be visually represented in VE, in 1989 Lanier established a "networked virtual world system" (Paul 2003: 125) enabling people "to see, talk, move and interact with one another within a shared synthetic environment" (Dixon 2007: 367). *Reality Built for Two* (1990) "allowed two participants to share a virtual world" (Lanier 2001: 3) from remote locations as a "telecommunications medium, which combines aspects of virtual reality with video conference" (Lanier 2001: 4). This aimed "to allow people separated by great distances to interact naturally, as though they were in the same room" (Lanier 2001: 4), something Lanier had been thinking about years before at the advent of VR. "I was immediately obsessed with the potential for multiple people to share such as place, and to achieve a new type of consensus reality, a 'social version' of the virtual world." (Lanier 2017: 46).

The shift in VR from a solitary and individual experience to one that is a shared, multi-person VR experience has gathered increasing popularity as a result of the COVID-19 pandemic's global lockdowns through 2020 and 2021. Participants are together in a shared VE, accessed remotely from different locations (e.g., from people's homes or workspaces). These VR platforms have enabled social spaces for interaction at a time of restricted movement and

socialising, offering “machine-mediated relationships on networked devices” (Turkle 2011: 11), labelled as Social VR. Examples of social VEs range from co-working, meeting spaces and industry events, socializing and gaming events, festivals, more traditional performance and music, and immersive theatre. The form of social VR has enabled “substitutes for connecting with each other face-to-face” (Turkle 2011: 11) at a time of restricted travel and physical social contact.

Prior to the COVID-19 pandemic, multi-person VR frameworks had been developed and were increasing in popularity as shared VEs – with participants not just occupying the same virtual space but also co-present together in the physical environment. Gamers gathered together in large warehouses ready to enter into a shared VE gaming experience, and VR industry events and installations were participatory across both physical and virtual realities. The technological frameworks that have been used in this research fall into this category, i.e. a VR experience in which the participants are together sharing both physical and virtual environments. These multi-person VR frameworks have enabled me to understand the experiences of co-present participants across both physical and virtual environments and the relationships between those within a VE and those that are not, i.e. occupying the physical environment in which the technology is located. The co-presence of bodies within and outside of VR has resonance to the relations between performers and audience members in dance and theatre. This is an area which I have explored with dancers and participants in developing participatory performances *Figuring* and *Soma* (see Chapter Three), in exploring modes of connection across seen and unseen, physical and digital boundaries. These VR frameworks offer possibilities for exploring the ways in which participants can cross between the physical and virtual environments, further unpacking the different experiences of the perception gap between the seen and the felt.

In the physical environment – the real world – it is typically visual information that grounds interactions between people, although underlying the visuality of human exchanges are lots of subtle cues which arise through non-visual sensory information, such as sound, touch, temperature, etc. This non-visual sensory information is usually missing from a VE and, therefore, the ways in which interactions occur within a social VE arise from visually led cues only; the way in which someone looks, their visual identity in that VE. The other sensory cues are not present, and this reduction of social relations to the visual is problematic. As a dancer, who trains her senses away from a reliance on vision, I bring a different

perspective and sensibility to VR, through which arises this issue of VR's sensory disruption. Seeing is less dominant in the synaesthetic practices of dance improvisation, as all of the senses flex in navigating the human and non-human relationships that open up in the dance. Using VR frameworks in which bodies are co-present across both physical and virtual environments, I explore the layering of sensory cues which emerge across physical and virtual bodies and environments and the confusion or tension that arises between them. I am curious to find the movement and play in these moments of sensory disruption, through my own bodily experience and through guiding participant interactions. In tooling or priming a participant in a dance-based mode of sensing, the discrepancy between the physical and the virtual can be further exposed for them, and by supporting the presence of both realities, there can be a continued interplay or dialogue between them.

The Ethical Implications and Issues of VR

The somatic sensory processes that I use to tune into my body, and to tune as a body that is sensed as part of a relational field with others and with the surrounding environment, do not cease to occur when I enter into a VE. Dancing, as an improvised and sensorial practice, provides a tuning which uncovers the depth of both the internal and the external world. The dancer is "both open to the world and intensely grounded in an awareness of one's ongoing experience" (Cooper Albright 2003: 260). Cooper-Albright draws on Simone Forti's description of a 'dancing state' to describe "the kind of solid physical awareness and subtle mindfulness that must be engaged as the corporeal foundations for improvising across our own experience" (Cooper Albright 2003: 260). Entering into the VE from a dancerly standpoint, I experience a heightened sensation of the perception gap between the seen and the felt, and this experience forms the basis of this research. Through practice-led investigations, I have drawn from these dance sensibilities and tuning practices to create participatory experiences for others in VR. During this process, my experience of working with different groups of participants, ethical issues and concerns of this participatory research into VR have been brought into focus. The ethics of these issues and concerns have been considered, in depth and detail, framed through a dance-based practice.

The VR industry is a fast-moving field with emerging and changing platforms and multiple versions of technologies. With a lack of specific guidelines and regulations for using VR in multi-person participatory scenarios, I sought to draw from my own dance-based knowledge

of participatory activity (The Touch Diaries intergeneration community dance project), applying this to an engagement with the technology. The characteristic affordance of VR is presence, the optical illusion of being there in the VE, and as part of the unfolding events that are taking place within that VE, even though there is an awareness of being located in a physical environment. Illusions of place and plausibility (Slater 2009), of being proximal, or even intimately close, to events, locales, etc., brings up ethical questions with regard to the effects of risky content (Madary and Metzinger 2016). Through VR's power of immersion, there is the potential for distress, trauma, persuasive/coercive material, etc. The critical responsibility is on how the producers of VR experiences consider and make ethical decisions on this content/material and also how they place choice or agency in the modes of participation, i.e., by informing participants of the material and any potential effects in advance of the experience. Madary and Metzinger offer important ethical findings and identify a number of ethical challenges posed by VR:

> There has been a good bit of attention devoted to the exciting possibilities that this new technology and the research behind it have to offer, but there has been less attention devoted to novel ethical issues or the risks and dangers that are foreseeable with the widespread use of VR. (Madary and Metzinger 2016: 1)

Regarding the ethical practices of immersive and participatory work using VR technology, I bring my dance-based understanding, practice and attentional skills to the conversation. In this research, I have sought to find practice-based responses to the ethical issues posed by the technology and to my concerns around participation. I have applied these practices to the participatory workshops and performances, which offer the sensibility of non-hierarchical relations of care across human and non-human worlds. However, the broader ethical grounds for VR, some of which are laid out by Madary and Metzinger and cover areas of psychology and physiology, as well as social, cultural and political implications, are too extensive to cover here.

The use of VR as a tool to manipulate and control exposure to simulated virtual environments in "extended interactions" (Madary and Metzinger 2016: 4) has led to "fundamental changes, not only on a psychological but also on a biological level" (Madary and Metzinger 2016: 4). Humans adapt to their environments, and this is especially relevant "due to the fact that VR introduces a completely new type of environment" (Madary and Metzinger 2016: 4), and

places the participant in the centre of it: their "entire environment is determined by the creators of the virtual world" (Madary and Metzinger 2016: 5). Madary and Metzinger write that these virtual environments, unlike the physical world, "can be modified quickly with the goal of influencing behaviour" (Madary and Metzinger 2016: 5), potentially without the user being aware of this influence (Madary and Metzinger 2016: 4). Providing tools to support an opening of somatic and sensory awareness, my practice with the technology offers routes through which attention can be shifted toward the physical body and environment whilst a participant is engaged within a VE. I am not advocating against the capacity for VR to enable fully immersive experiences, for participants to leave behind all aspects of their physical reality in favour of a virtual one, as this can be a very useful tool in certain circumstances (such as pain relief). Instead, I bring into play another available option for participation and the potential for increased participatory agency.

Further ethical challenges occur in VEs that are shared remotely, as there becomes the potential for difficult and harmful behaviour between interactors in these spaces if specific codes for conduct are not set up and maintained. A phenomenon, termed the griefer culture, bringing harmful behaviours and situations of harassment, has emerged from the rising trends of social VEs. In these social VEs, the grounds for participation are left up to the individual's discretion; rules or codes and conventions of play or interaction with others – such as how to approach another participant, how close to move into their personal space, touch, or even move through, their avatar, and whether it's appropriate to interrupt or disrupt someone – are not defined, enabling these difficult situations to emerge.

Whilst social VEs present a more embodied medium for remote connection and interaction with screen-based applications, such as Zoom or Skype, some social VEs have been widely criticized for being exclusionary and perpetuating harmful behaviour. As a result of this, questions around the safety and well-being of the participants are being raised. Taking into consideration issues such as proximal appropriateness, ownership of avatar/virtual body and modes for interaction, Michelle Cortese and Andrea Zeller write on developing models for designing safer social VEs (2019). Due to the immersive and participatory nature of VR, "when someone threatens or violates your virtual body, it can feel very real" (Cortese and Zeller 2019), and this innate physicality of VR can lead to a "visceral quality of VR abuse" (Cortese and Zeller 2019). Cortese and Zellar are engaging with and developing "a practice into looking at body sovereignty and ownership as an interactive principle to ensure safe,

inclusive social VR spaces and help maintain a healthy virtual embodiment" (Cortese and Zeller 2019). It is crucial to find ways to ground these virtual social spaces in a participation that reflects positive body-to-body and body-to-environment relations, reinforcing good habits and challenging unhelpful behaviours. These spaces need to centre on the safety and well-being of participants, as well as supporting the needs of specific communities and people, and working with difference can support this inclusivity. This was a consideration in planning my research workshops, key aspects of the designs for which were about creating possibilities for play and exploration across and within both the physical and the virtual environments and building a sense of care through partner-practices and one-to-ones, as well as group dynamics and relationships.

A reimagining and constituting of participatory grounds in social VEs, taken on in part by Cortese and Zeller, needs to consider not only the interaction of bodies in these spaces but also the spatial conventions in which these interactions take place. Media and communications scholar Michael Saker and sociologist Jordan Frith describe a paradigmatic shift taking place in how participants in mobile VR devices experience space. They write that the "advancing freedom of VR" (Saker and Frith 2020: 1437), brought on by the development of mobile and untethered systems, is "forging an altered relationship between the physical, digital and concrete space" (Saker and Frith 2020: 1435) and participants are "not restricted to a limited environment but can physically roam a much broader, coextensive space" (Saker and Frith 2020: 1437). Saker and Frith's research suggests "the physical and digital are dynamically interwoven in new ways that move beyond the contiguous" (Saker and Frith 2020: 1439) and come together in creating this coextensive space. They argue that the VE becomes "dislocated" (Saker and Frith 2018: 10) from the physical environment in which it takes place rather than separated or absent from it and, through this dislocation "the shared norms of actual space" (Saker and Frith 2018: 10) remain a constraint upon actions in the virtual space and are, therefore, "a way of understanding the embodied space MVR [mobile virtual reality] might configure" (Saker and Frith 2018: 214). They write, "[t]he role of VR, then, has often been to transport users to a separate virtual environment that fleetingly creates the illusion of difference by removing the visual inclusion of concrete reality" (Saker and Frith 2020: 1435). Their notion of dislocation brings about "an altered relationship between the physical, the digital and concrete space, through the mediated inclusion of concrete reality" (Saker and Frith 2020: 1435-1436). Whilst these researchers are saying that the concrete, physical reality dislocates an experience of the virtual, an idea in opposition to

my own practice with the technology, they are also commenting on the interwoven nature of the physical-virtual, and the inclusion of physical reality in an encounter with VR. The use of 'dislocated' as a term used to describe the sensation of the physical environment does not work for my own sensibilities of these conflating environments, as to have a dislocated limb implies the lack of ability or agency to move and sense that limb. In this research, I follow a practice of locating my body, other bodies and the environment across physical and digital, corporeal and incorporeal, territories. Through this practice, and through a sensing which does not rest or rely on the visual, there can be an open access to all areas of the experience. Tooling participants to sense the physical environment non-visually can increase agency, and bodies can become relocated, not dislocated, across different terrains of presence.

Artists and Technology, and the Somatic Turn in HCI and Dance

This section expands the contextual framework for this research from the discussion on VR technology to its consideration and use by artists: outlining some of the ways in which body-technology relations are considered and created by artists working with technology, in particular with VR. I explore how artists centre the body and the senses in performance across the genres of MRP and immersive performance and the tools and practices used by artists to support these immersive and intimate participatory encounters. I then approach how body-technology relations are considered and dealt with in the field of HCI and how the recent somatic turn in HCI resonates in some ways with my own practice, which combines somatic-dance tools with multi-person VR technology.

Many artists working with VR work with the way in which the technology immerses and relocates the participant to create specific participant experiences which take them into a body or environment which is different to their own. Artist Jane Gauntlett explores her personal experience of brain trauma and epilepsy in the 360-degree VR film *In My Shoes* (2017), an experience which, according to reviewer Philip Ellis, "is as close as you can get to literally being somebody else" (Ellis 2016). *The Machine to be Another: Embodied Virtual Reality System* (2012) is similarly a VR experience which "allows individuals to experience the world through the eyes and body of another" (BeAnotherLab 2012). These works, and many others, draw upon the capacity of VR to create illusions of body ownership and of place. *The Machine to be Another* was designed with the aim to "stimulate pro-social behaviour and overcome intergroup social barriers" (BeAnotherLab 2012), taking into

consideration in the design of the work the lasting effects of the immersion into VR. Brooke Belise, assistant professor in visual culture, and Paul Roquet, assistant professor in media studies, write critically on the notion of VR as an empathy machine, which sprang up from a 2015 TED Talk given by innovator Chris Milk claiming that VR could enable "participants to feel humanity in a deeper way and to empathize in a deeper way*"* (Belisle and Roquet 2020: 7). Belise and Roquet argue for a more complex dialogue around this debate, that "VR's increased sensory immersion directly translates to an increased potential to generate empathy, and that this can be a vector for social change" (Belisle and Roquet 2020: 7). They "contest simple arguments about empathy to find more analytically and critically precise vocabularies for the affects and emotions produced with and through VR" (Belisle and Roquet 2020: 7).

The use of VR as an empathetic device is explored in immersive experiences designed to encourage the participant to take someone else's body or viewpoint. A participant can step into another's lived experience, and feel what they feel, without having that lived experience. This idea brings with it a range of problematics, including the ways in which the participant, in order to take on another's body and environment, is required – on some level – to lose their own. The simulated body and environment are forefronted in the experience, and the reflection and integration of the experience take place after the technological encounter, once the participant has removed the headset and is back in their physical body and located in their surrounding physical environment.

In this research project, I open up a dialogue between the physical and the virtual within the experience of the technology itself. I am interested in creating VR encounters that are not bound to a total immersion within the VE for the whole duration of the experience of the technology. I invite participants to explore a movement of attention and thus of perception between the two realms of presence – the virtual and the physical – whilst they are engaged within the VE. In attending to these oscillating states of presence, there can be new possibilities for an engagement with the body, with other bodies and with the environment – as corporeal and digital – and in ways which open, beyond the visual, into the realm of the felt. Using dance practices in combination with VR, I hope to enable more embodied and empathetic exchanges between participants and their environments, which are not centred on the visuality of the body or the environment but on its felt presence. This can also translate to exploring the bodies and places of the virtual, of 'other' in relation to this felt sensing and to the corporeality of the living world.

There are artists who, aligning with the practice of this research, "radically refigure" (Hansen 2006: 4) the experience of VR as a complete takeover of reality. Artists who reconsider technology as "simply one more realm among others that can be accessed through embodied perception or enaction" (Hansen 2006: 5). As installations, performances and games, MRP is a genre of participatory experience that combines both ubiquitous and immersive facets of technology "as two opposing forces at opposing ends of the virtuality continuum" (Benford and Giannachi 2011: 4). "[T]he basic concept of the mixed reality state: a virtual space full of information" (Grau 2003: 1875) which is "activated, revealed, reorganised and recombined, added to and transformed as the user navigates" (Grau 2003: 1875) fluidly between virtual and physical realms. MRP shifts theatre-based conventions, transforming "traditional audience members" (Benford and Giannachi 2011: 5) into "interacting participants" (Benford and Giannachi 2011: 5) and who become "performers in their own right" (Benford and Giannachi 2011: 5). The term 'immersive' is used, not only to define the use of VR (and other) technology in mixed reality participatory experiences, more "widely to define a style of performance practice" (Machon 2016: 36). Immersive performance/theatre differentiates itself from more traditional theatre conventions and settings by removing the stage and immersing the audiences or participants in the performance itself. These performances often use technology to support the immersive nature of the experiences they offer, crucially, the participant is placed at the centre of the experience, "whose direct insertion in and interaction with the world shapes and transforms [potential outcomes of] the event" (Machon 2016: 36).

In the virtual worlds of immersive performance, participants are actively "submerged in a medium that is different to the 'known' environment" (Machon 2016: 34), in which "space, scenography, sound and duration are palpable forces that comprise this world" (Machon 2016: 34). The participatory journeys of these performances are active and sensorial, prioritising the bodies of participants and including all the senses, "the audience-participant is haptically incorporated" (Machon 2013: 207), and sensing becomes synaesthetic.

> Spectating becomes a whole-body pursuit; sharply focused, visual and tactile perception combined with the haptic, peripheral appreciation of the space activates whole-body attendance and invites a multi-layered comprehension. Within immersive worlds, inhabitants become attuned to dwelling – dwelling in time, in a space,

> dwelling in their activity during the event and dwelling, attentively, in their own bodies. (Machon 2016: 46)

The participatory journeys I have designed and delivered for this research are those in which bodies and environments are actively transformed through the attentional, physical, sensorial presence and interaction of the participants. This body-based and movement-centred participation is activated through initiating and guiding a somatic-sensing, a tuning into the body, in building up a lively and felt physicality of presence. Through this practice, there opens up a shifting relationship, a dialogue between sensing drawn from the visuality of the immersion of the VE, and sensing the felt, physical body which is located within the physical environment and with other bodies. Philosopher and social theorist Brian Massumi writes, "[t]he body, sensor of change, is a transducer of the virtual" (Massumi 2002: 135). The dichotomy between virtuality and corporeality, "the paths of their cooperation – transformative, integration, translation, and relay – are themselves analog operations" (Massumi 2002: 143), arising within the body as sensations. "Sensation, always on arrival a transformative feeling on the outside, a feeling of thought, is the being of the analog. It is matter in analog mode" (Massumi 2002: 135).

The somatic and sensory liveliness in my body, the affective resonance of continued exploration into embodied movement through my dance-based training and experience, becomes a responsive mechanism when I am assembled with VR technology. My research is driven by this liveliness which, as Kozel writes, "provides an authentic stance from which to reflect upon the wider implications of human bodies using digital technologies" (Kozel 2007: 12). I have used workshop practices with groups of participants to find different ways to activate this liveliness, which has been initiated through my own bodily experiences, in the bodies of others and to support and build the design for the participant journey in the performances.

> As a dancer, hearing anyone claim that virtual technology demonstrates the futility of the body makes me want to dig my heels in, theoretically and practically. Yet this is a commonly held belief, based on the recognition that in much of the technology consciousness is drawn out of the body and into an electronic construct. Yet, for me, the experience was one of extending my body, not losing or substituting it. (Kozel 2007: 99)

In her work with technology, Kozel explores the performative terrain surrounding notions of intimacy and otherness in body-techno assemblages. Deeply present in this work is her embodied understanding of the complex layering and intertwining of bodies and machines in these assembled forms. She draws on Merleau-Ponty's notion of flesh and uses the web of fascia, which forms a connective tissue throughout the body as a metaphor, to explore the intimacies of relations between the human and the non-human world. Artists such as Kozel, who bring their bodily practices and sensibilities to technology, open up and problematise the complex relationality between body and machine.

Renowned performance artist, Stelarc extends his body in assembling with technology, distributing agency across flesh and machine. In his engagement with technology, Stelarc relinquishes the "control he is able to exert over his body by allowing it to be partly activated by the machine, to let technology affect the body" (Giannachi 2004: 59). In the alliance between his body and the technology, his body remains active and lively; it is not absent. I have witnessed many participants, users of VR technology, become passive in their engagement with the technology (and also with other technologies). Their bodies attune to the VE as the new surrounding environment, attentionally absent to this transference taking place. I seek, in this research, to awaken the body in its assembling with (VR) technology, to activate the passivity and to also break down assumptions around how bodies use technologies. As media choreographer and scholar Johannes Birringer writes:

> If one reads and experiences the world through code and dispersive networks … one wants to know what kind of closeness or intimacy is involved and how it moves 'across'. Implied in the movement, there is also an assumption about the difference between the visceral and the digital, and this assumption concerns us here. (Birringer 2012: 143)

My work with VR technology uses dance-based tools, such as closing the eyes and using touch to sense the body and other bodies which are moving together as felt, non-visual forms, to shift a participant's passive reliance on the visual and encourage a livelier, synaesthetic mode of sensing. As the perception gap is exposed, and through practices of attention toward the somatic felt sensing body, it (the body) becomes a more active and agential force in assembling with technology. In her immersive pieces *Osmose* (1995) and *Ephémère* (1998),

Char Davies uses VR to "catalyse a shift, as well as to compel self-reflexive recognition of the shift, from a predominately visual sensory interface to a bodily or affective interface" (Hansen 2006: 123).

In *Osmose,* participants draw from their non-visual senses and their breath, which opens up a dialogue between their bodies and the simulated visual world. In Davies' work, the participants, whom she refers to as *immersants*, wear a motion tracking body vest that monitors their breathing and balance and provides sensory feedback, and they have the ability to negotiate the immersive VE hands-free. The visual information seen within the HMD is purposely low resolution to actively counter the conventional VR emphasis on vision. The work "compels the viewer-participant to reconfigure her sensory economy, such that (at the very least) vision becomes thoroughly permeated by tactility and proprioception" (Hansen 2006: 110). Aligning with my own ideas and sensibilities for participation in VR, Davies' work offers an engagement with VR technology through the body, bringing the body into an engagement with the VE through opening the participant's awareness of their own somatic sensing and reducing the conventional emphasis and reliance on vision.

In order to recalibrate the participant's modes of sensing towards the felt and away from the seen, I draw on practices of visual sensory deprivation (such as working with the eyes closed or in a blindfold), which are used in dance improvisation and somatic practices to de-centre vision in its dominant role in the sensory system. This re-tuning process, discussed in detail in Chapter Two, combined with VR technology, reveals or heightens the experience of a VE as a layered environment. Instead of a replacement to the physical world, the VE becomes an environment that is sensed alongside it, and, as the worlds intertwine, the experience becomes more complex to the senses. The HMD may be a blindfold to the physical environment, but the physical world has not gone away. Rather it is sensed non-visually through this dancerly tuning. Participatory processes of "[r]emoving sight in an immersive performance" (Machon 2016: 42) are used as a tool for "heightening those senses often deemed as secondary" (Machon 2016: 42) so to "enable the interactor to be sentiently engaged with the world" (Machon 2016: 42-43). These processes offer a "double perspective" (Pallasmaa 2017: 97), which "comprises a facilitated awareness that one is observing oneself from inside oneself, which correlates to the way in which one comprehends and interprets the piece" (Machon 2016: 43). Being blindfold, or deprived of the visual sense in some way, enables this awareness. The eyes can turn inwards as the visual stream of

information on the outside of the body is reduced or taken away, and sensory attention can flex and re-organise.

On exiting the VE, and on the return of visual information as participants take in the physical world through their eyes once again, "[a]t the points one is sighted, one is encouraged to look and look again, to look with the whole body" (Machon 2016: 43). This process, discussed by Machon, and by cultural philosopher and sensory architect Pallasmaa, of revealing the layers of sensing that are taking place in one moment through a de-centring of vision – between vision and the other non-visual senses – is extended in my practice which incorporates VR technologies. The VE opens further the discrepancies or perceptual gaps between the senses – seeing and feeling – and thus reveals the different modes of sensing to each other. The returning, sighted once more, is also explored in the practices of this research, in the moments on exiting the VE and in the moments beyond.

The participant, using practices of sensory deprivation in participatory performance, is placed into the hands of the artist and the performers involved in delivering the experience. In this hand-over, there is the potential for the participant to feel vulnerable or lacking in agency. A duty of care between performer, artist and participant is required in these situations; a 'contract for participation' which needs to be "shared early on between the spectator and the artists, inviting and enabling varying modes of agency and participation" (Machon 2016: 35-36). In VR, with the HMD serving as a form of sensory deprivation, with the participants losing their sense of sight of themselves, each other and the world around them, there needs to be a similar contract – a placing of trust in the performer and a commitment to or investment in the experience from the participant. From the moment of handing over their belongings to the residual effects of the immersion beyond the engagement with the technology, this contract or duty of care needs to be in place, transparently known about and understood by all involved. The rituals and practices which are used to form these contracts in immersive performance can offer learning to the developers of social VEs who struggle to find ethical participatory cohesion in their virtual spaces (Cortese and Zeller 2019).

In the practice of this research, I have considered the sensory deprivation of VR as an ethical issue for the participant and what dance-based training can offer to support and enhance participant experience and agency around this aspect of the experience of the technology. In this research, the participatory experiences operate through processes of building a sense of

trust and setting up relations of care between all those involved – the participants and the performers, the technicians and other collaborators. These practices occur through touch, spoken invitations and conversations, and through the physical movement and sensing of bodies across physical and virtual environments. Care in these practices is not about one body domineering another, but a shared exchange. It is an offering and a guiding that is reciprocated. Each body offers difference through its unique acts of sensing, movement and dialogue. These differences are not part of a structure of power, they do not operate as a hierarchy, but each different adds something new into the conversation, making the experience richer.

Across the field of HCI and its associated fields, there has been a recent turn toward the body and to somatic practices as means and methods for designing human interactions with technologies. This turn resonates with my own approach, which combines somatic-dance practices with VR technologies, and also brings up notions of difference in how bodies are considered and ideas around embodiment in human-technology/machine assemblages.

> The pioneering work of flight simulators, of head gear, foot pedals and other apparatuses that would discipline the body to conform to a regime of screen-based and device-driven affordances made the discussion of these relationships into a field of its own known as Human-Computer-Interaction. (Drucker 2011: 1)

Historically, much of the focus in technological development – from industrial and scientific to military technologies and from architecture to civil engineering – has "played down the relationship between people and technology … in favor of something more objective, on the basis that objective analysis is required to advance theory and change practice" (Drucker 2011: 2). Growing out of a "collaboration between the disciplines of computer science and psychology" (McCarthy and Wright 2007: 6), disciplines are "directed more toward functional accounts of computers and human activity than toward experience" (McCarthy and Wright 2007: 6). HCI studies attempt to improve interactive experiences through developing and improving the technology in its efficiency and functionality. This method of designing and developing human-technology interactions has required the user of the technology to adapt and conform to the affordances of the technology rather than for the technology to conform to those of their body.

In recent years, there has been a shift in thinking in HCI, spurred on through technology's increasingly pervasive and mobile role in cultural activity. HCI has been facing challenges as the "use context and application types" (Bodker 2006: 1) of technologies and machines are "broadened, and intermixed" (Bodker 2006: 1). "Technology spreads from the workplace to our homes and everyday lives and culture" (Bodker 2006: 1) and "as computers have evolved considerably in their short history, so have styles of human-computer interaction" (Dourish 2004: 5). There are many associated fields to HCI, such as Human-Machine Interaction (HMI); Human-Centred Design (HCD), and their sub-disciplines of User Experience and User Interface Design (UX and UI), as well as Ergonomics and Human Factors (HF), all of which engage in design-led processes which revolve around in-depth approaches to designing and developing technology centred on developing an empathic understanding of the user. Computer scientist Paul Dourish argues for an "embodied approach to interaction, as an aspect of emerging HCI design practice" (Dourish 2004: 208) and writes about human-computer relations as a "fundamentally embodied phenomenon" (Dourish 2004: 145).

Dourish's work, alongside others in HCI and these associated fields, is part of a resurgence of interest in the concept and practice of embodiment taking place more broadly across the cognitive sciences, in fields such as embodied cognition, and in affect theory / the affective turn in the humanities. Specifically, the idea that "the brain is not the sole cognitive resource we have available to us to solve problems" (Wilson and Golonka 2013: 1) and that "[o]ur bodies and their perceptually guided motions through the world do much of the work required to achieve our goals, replacing the need for complex internal mental representations" (Wilson and Golonka 2013: 1). These notions have changed the parameters for understanding human cognition and opened up the notion of embodiment as "not simply another factor acting on an otherwise disembodied cognitive process" (Wilson and Golonka 2013: 1).

Dancers and their practices can bring a more nuanced understanding to the conversation and practice around the body in areas of technological design and development as well as in areas of cognitive science, i.e., embodied cognition. In this research, I bring my dance-based embodied knowledge and practices into a process of designing participatory investigations with VR technology. I have found that mixing somatic-dance and improvisation practices with VR expose bodily and sensorial habits and offer tools for shifting them through an increased awareness. Cultural and media theorist Mark Hansen writes about the inherence of technology as already absorbed into human embodiment:

> Technicity, understood in its broadest sense as a relation to exteriority, as exteriorization, is not and cannot be something merely added on to some 'natural' core of embodied life. Rather, it must be understood to be a constitutive dimension of embodiment from the start. (Hansen 2006: ix-x)

As Hansen remarks, technologies later onto the body and also into the body, becoming some aspect of the body itself, forging modes of perception and embodiment. Immersive technologies, such as VR, operate in less liminal ways to the more pervasive/mobile technologies. Yet, the body adapts to serve an engagement with any technology, the body conforms. Technologies such as VR operate with the visual sense as the core processing aspect of sensory engagement, and the human participant responds through prioritizing their visual sense as dominant over the other senses. The 'normative' (Western) human sensory system has evolved as vision-centric, and vision-centred technologies like VR feed this organization of the senses, further suppressing or inhibiting other sensing and, therefore, perceptual and embodied pathways. Maxine Sheets-Johnston, a scholar in philosophy and dance studies, questions the use of the term 'embodiment' in its representation of "the subject's perceptual experience of his/her own body" (Sheets-Johnston 2009: 336) as a visual phenomenon. Echoing my own concerns, Sheets-Johnston argues that body image "fails to capture" (Sheets-Johnston 2009: 336) the whole of embodied experience and "leads us far astray, for the first and foremost perceptual aspect of one's own body – and in fact, any living body – is its movement" (Sheets-Johnston 2009: 336). She writes, "[t]he basis on which we make our way in the world" (Sheets-Johnston 2009: 222) is "through movement of our tactile-kinaesthetic bodies and through our related, developmentally achieved corporeal concepts" (Sheets-Johnston 2009: 222). My own thinking and embodied practice are grounded in the sensations of my body as dynamic and relational, a moving, sensing entity that operates through sensing, which is neither fixed nor reliant on vision.

Renowned psychologist J.J. Gibson, whose ideas have been used as building blocks for perceptual understanding in the development of technologies such as VR, writes that "[o]ne sees the environment not just with the eyes but with the eyes in the head on the shoulders of a body that gets about" (Gibson 1986: 222). Whilst Gibson brought the body and the movement of the body into the act of seeing, his notions still orient perception around vision – the eyes as the centre point from which all bodily sensation and experience is initiated. An

ocularcentric perspective, "[t]he domination of vision in our knowing and thinking about the world" (Belova 2006: 93), has led to "objectivist and disembodied understandings of reality" (Belova 2006: 93), which disempowers and devalues non-visual sensory information in the formation of the perceived realities of bodies and environments and their relations; perceptions that are "built upon knowledge provided by optical technologies" (Ihde 1990). Technologies such as VR reinforce a (Gibsonian) visually led perceptual system and thus the habituated neural and embodied pathways between vision and the rest of the body. Consequently, the body's capacity for prioritising the other senses over vision is reduced. Extensive use of VR could potentially lead to a participant no longer being able to access or recognise other, non-visual sense-cues from the (physical) world around them as necessary information. Restricting the sensory pathway to always take vision-oriented routes may have long-term effects on how humans connect with one another and with the-environment, perhaps leading to a reduced capacity to feel and therefore the loss of a felt, empathetic connection across these relationalities. "As soon as I attempt to distinguish the share of any one senses from that of the others, I inevitably sever the full participation of my sensing body with the sensuous terrain" (Abram 1997: 60). This research seeks to tune up the non-visual whilst the body is located in seeing a VE, to expose this vision-centred habituated sensory patterning, and to explore the potential for a greater flexibility and agency in the senses.

My practice in dance draws significantly on somatic practices as a means through which to listen in to my body and to its relationality to the world around me. These processes call into action the somatic and interoceptive senses. These senses are described by, socioloigist, Mark Patterson as "the modalities of proprioception (the body's position felt as a muscular tension), kinaesthesia (the sense of movement of body and limbs) and the vestibular sense (a sense of balance derived from information in the inner ear)" (Paterson 2007). These senses work together "synergistically, as the inwardly-oriented sensations necessary for feelings of embodiment" (Paterson 2007: 4). Recent work in HCI, influenced by the work of Richard Shusterman, a field of theory and practice called Somaesthetics, shifts this visually led paradigm for embodiment. Drawing on Somatics, "the field which studies the soma: namely, the body as perceived from within by first-person perception" (Hanna 1991: 31), Somaesthetics grounded an understanding of the somatic senses "as the key process that integrates the senses in embodied perception" (Paterson 2007: 21), a perspective deeply "overshadowed by philosophy's privileging of the optical over the tactile" (Voparil and Giodano 2015: 144).

> Hanna reminded us that our birthright was the physical, fleshy body. Shifting the focus away from the objectified mechanized body, Somatics reminded us of the physicalized right to occupy space, to acknowledge potential for freedom and expansiveness, have dimensionality, feel, know oneself, be the agent of one's own actions and to form bonds with self, others and realized realms beyond self. (Batson 2014: 229)

Somatic practices are increasingly present and growing in popularity across contemporary society, "the emergence of a 'somatic turn' in contemporary thought" (Loke and Schiphorst 2018). This has been supported by a growing body of research demonstrating how they can be applied to support both physical and psychological health. Designed to "train awareness of self and environment through directed attention to bodily sensing, feeling, and moving" (Loke and Schiphorst 2018: 55), somatic practices enable an individual to open their awareness toward the interior environment of their bodies and the felt presence this brings to the physical world around. The subtle relationships that exist between the movement and weighting of the body, areas of bodily tone – tension and laxation, the fall of gravity, the flow of the breath, and specific qualities of touch to the ground or to surfaces around the body or to other bodies are brought into heightened perceptual attention. These practices are noted for being ways toward better health and wellness, taken by individuals, communities, and also as "critical approaches for health and well-being" used "by public health and medical faculties" (Loke and Schiphorst 2018: 56).

In my research, I bring dance-based somatic practices into an engagement with VR technology, a process that brings about an immediate tension in modes of sensing in the body, between somatic-based sensing and vision-centred sensing. This tension is the starting point for the practice I have developed, which has been initiated from the experience of my own body and has folded into designing participatory experiences in VR for others. Building on Schusterman's work, HCI-based researchers Thecla Schiphorst, Lian Loke and Kristina Höök similarly apply somatics to technological design practices, inviting a "rethinking of the process of designing for technology based on the emerging somatic turn within Human-Computer Interaction that acknowledges design for the experience of the self and recognizes the interiority of human experience as an equal partner in technological design processes" (Schiphorst, Loke and Höök 2020: 1). These researchers are interested in the ways in which

HCI designers and practitioners can "cultivate a somatic sensibility" (Schiphorst, Loke and Höök 2020: 2).

Interaction designer and architect, Elyne Legarnisson also draws from Shusterman's work and from Somaesthetics theory. She designed her VR experience, *(Un)Balance* (2018), to explore and challenge a bodily engagement with the world which, in her view, is becoming increasingly limited: "we increasingly evolve towards spatial contexts and interactions which tend to limit and control our moving bodies while dispersing our attention through constant visual stimuli" (Legarnisson 2018). She argues that "body awareness and body movement play key roles in our physical and emotional health" (Legarnisson 2018) and uses VR, challenging its primary use of vision, with wearable technology and a physical tilting platform, inviting participants "to play on the edge of stability" (Legarnisson 2018) bringing awareness to their perception of body and environment. This work is comparative to my own practice with VR, in particular the way in which Legarnisson uses VR against its key affordance, which is to create a visual simulated illusion, and to use it as a tool to open up bodily awareness and the potential for increased mobility. My research uses VR combined with somatic practices as a means through which to open up a bodily and sensorial awareness between the seen of the VE and the felt sensations of the body located within the physical world. Though shifting the participant's sensory axis away from visual dominance prior to entering into the VE opens up this layered experience rather than, as Legarnisson does, by putting the body into an extreme physical situation which requires a physical attendance to the body in relation to the VE.

Considering body-technology relations within the field and processes of HCI, considering the design and use of technology to encompass the complexity of human embodiment is as challenging as it is critical. "[T]he role and responsibility of the designer in creating technologies and interfaces that can take account of the somatic dimension, with its ethic of care, is yet to be fully realized" (Loke and Schiphorst 2018: 56). Some of these issues and complexities of bodies and the ethics of their embodiment in VR are addressed through the practices of this research in processes of self-observation, group exchanges with dancer and non-dancer participants, and collaborative processes with technical collaborators. These processes centre on designing and crafting practices to create participatory workshops and performances which open up a somatic awareness of the body and senses and, from this standpoint, reveal how the senses are required to be used in engaging with VR technology.

These practices question and challenge normative assumptions of the body and the organisation of the senses, and thus the nature of embodied relations with technology.

Somatic practices have contributed to processes of dance-making and training as "a potent means of investigation into pragmatic thereness, the sensate body with the inherent ability to create new events from itself (and through itself)" (Batson 2014: 229). Some somatic practices used in dance focus on visual imagery as routes into modes of sensing and feeling, such as Eric Franklin's *Ideokinesis* and the *Skinner Releasing Technique* (SRT). Others, such as Body-Mind Centring, use anatomical information, from the cellular to the fascial, to enter into bodily sensing, feeling and movement. For many dancers, myself included, somatic processes and investigations lead into improvised movement and performance material. Dance artist Simone Forti describes this type of somatic process in her work with (post-modern) dance pioneer Anna Halprin, which led to "short improvisational studies" through which "a great variety of movement material became available to us" (Forti 2003: 54).

> A major part of our movement training with Anna was based on anatomical explorations, understanding the bone structure of the shoulder area and then spending a half-hour exploring its range of movement, engaging muscles or releasing them to the forces of gravity and momentum, pushing, taking weight, noticing the resulting dance as the whole body supported this exploration. (Forti 2003: 54)

Dance scholar Sarah Whatley writes, from an observational perspective, about a project combining somatic practices and technology led by dance and visual artist Ruth Gibson, exploring "the intersections between the technological process of motion capture and a somatic body-based movement practice, Skinner Realising Technique (SRT)" (Whatley 2015: 193). Whatley describes the ways in which the technology "intervenes in, supports or constructs the artist's making processes" (Whatley 2015: 193).

> The intertwining of SRT and dance practice lies in this relationship between the image and the dancer: Each regenerates the other to provide a potent creative force that emerges through a process of mutual becoming rather than a unilateral invention. Imagery is thus fundamental to a dancer's perceptual awareness and for enhancing the communication of kinaesthetic data. When brought into the domain of motion capture, image is both input and output, generating and transforming whilst

> virtualising the sensory, corporeal world with which it participates. (Whatley 2015: 203)

In her writing, Whatley draws on Sita Popat's experiences as a somatic body encountering technology to "remind[s] us, the inclusion of technology can actually heighten and stimulate bodily awareness" (Whatley 2015: 199). This notion is central to this research, which uses the affordances of VR to activate or enliven a somatic sensibility. Popat's ideas are discussed in more detail in Chapter Two, in considering her experience of Gibson and Martelli's VR experience, *White Island* (2014), in which her proprioceptive and kinaesthetic senses came to the fore in her relations with the VR technology.

One of the key features of somatic-dance and improvisational processes, and crucial to this research, are the tuning practices undertaken by dancers, which deprive the visual sense as a method to access a non-visually dominant mode of perception. In these tuning processes, dancers (myself included) work with their eyes closed or in a blindfold, also in (interior or exterior) dark spaces, to locate and sense the body in the absence and dominance of visual information. Moving in a state of darkness, the sensory system (temporarily) re-adapts, tuning into non-visual and interoceptive sensory information. In these practices, there is an activation of the "under-examined somatic (bodily) senses" (Paterson 2007: 3).These senses, of touch, sound, temperature, proprioception and the kinaesthetic sense, are "imperative in understanding the manifold senses of touch and their integration" (Paterson 2007: 3) - as a mode of perceiving the body and its felt relationality toward other bodies and the environment. When visual information is brought back into play, after regular practices of sensing and moving in darkness, 'seeing' becomes integrated with, not dominating, the other senses. Enhanced with "synaesthetic potentials" (Little 2016: 97), the senses are enlivened in their active participation in perception. Through this sensory tuning and training, the dancer can begin to move with her eyes open, her vision infused with other sensory properties. This is a phenomenon which I can evidence through my own lived experience and practice, revealing the senses as a multimodal and dynamic system.

In the visual space of the VE, the integration of vision with the other senses is based predominately on visual data. Philosopher and social theorist Brian Massumi writes:

> All the sense modalities are active in even the most apparent monosensual activity. Vision may ostensibly predominate, but it never occurs alone. Every attentive activity occurs in a synesthetic field of sensation that implicates all the sense modalities in incipient perception and is itself implicated in self-referential action. (Massumi 2002: 140)

Whilst "the eyes want to collaborate with the other senses" (Pallasmaa 2012: 44), the body is reduced in its capacity to feel and sense the VE in the nuanced way that integrates touch and the other senses with sight in the physical world. In a VE, the other senses cooperate with vision as their driver, and this reduces their flex within the sensory system. Yet, within the VE, the moving, sensing relational body is always available, a "dynamically attuned body that knows the world and makes its way within it kinetically… thoughtfully attuned to the variable qualities of both its own movement and the movement of things in its surrounding world" (Sheets-Johnston 2009: 61); "Any time we care to turn our attention to it, [however,] there it is" (Sheets-Johnston 2009: 61). In the practice elements of this research, I have brought somatic and improvisation practices into a participatory engagement with the materiality and virtuality of VR technology, drawing from the ways in which 'dance bodies' support, witness and guide one another to support partnering and performance relations between dancers and participants engaged in VR. I have extensively explored the use of touch as a method for grounding a participant located in a VE into their physical body and into their body's connection with the physical environment and with other bodies co-located with them in the physical space. Through chapters Two and Three, I will explore how these practices expose the perception gap between seeing and feeling and offer a bridge between physical and virtual states of attention and presence.

To conclude the first part of this chapter, I briefly outline some of the key issues and questions that have been raised in dealing with the complexities of assemblages of bodies and technologies.

Firstly, I have discussed the histories and applications for VR technology and how artists are engaging with immersive technologies such as VR in their practices and in developing participatory performance work. I have considered the field of HCI and how, in this field, the body of the user in the interaction with technology is considered in design and development

processes. I draw comparisons between different understandings of body and embodiment in HCI and its associated fields and in dance practices.

Secondly, through these histories and contexts on body-technology relations, I have discussed the immersive nature of VR technology and the sense of 'being there' in the VE, increased through the presence of a visual virtual body that the technology affords. I have laid out an alternative mode of presence, which is a counterpoint to the visual VE, using sensory practices of attention and which are employed in dancer training processes. In their attentional co-existence, these two modes of presence expose the perception gap between seeing and feeling.

Finally, I have opened up a discussion on the complexity of the ethical issues surrounding participation in interactive multi-person VR frameworks, such as those used in this research. I discuss the dance-based approach that I take in response to some of these ethical concerns: to invite or tune a sensory-somatic flexibility and agency in the VE; to draw on partner-based relations to support relations of care between the bodies of participants and dancers, connecting as guides and witnesses for each other, and operating inside and outside the VE. Questions of whether or how participants experience the perception gap from within a VE lie in what they bring – the patterning of their own sensory habits, perceptions and embodied awareness, their preconceived ideas and expectations of (VR) technology, and their openness and adaptability to inherently change. There is an offer to the participants of this research to share their differences and to challenge the work. This is invited through the responsivity creating within the scoring of the workshops and performances, an approach that also resonates with my approach to creating work more broadly. The questioning of the normative and the bringing of difference is invited so that the questions around human-technology relationships can be broadened and cultural ideas and references which permeate online virtual spaces are broadened/questioned/challenged.

Part Two:

The Meshwork, Body-Environment-Technology Relations

In the second part of this first chapter, I bring in the thinking of the key theorists which evidence my thinking and practice, centring around the complexities of relations between

bodies and technologies. The words of cultural and feminist theorists Erin Manning and, philosopher of science, Karen Barad have influenced my creative, sensorial and movement processes of considering the body and its relationality to other bodies and to the world around me. Their words correlate wholly with the embodied somatic and improvisation practice that I undertake as a dancer. As does the intrinsic relationality between the human and the non-human, the vitality of the non-human in Jane Bennett's *Vibrant Matter* (2009). This thinking to my practice extends from the body to the space or environment to encompass technology; to consider technology as part of "the complex interplays that ultimately make the entire world one system" (Hayles 1999: 290). This same system is described by social anthropologist Tim Ingold as a *Meshwork* (2016), an idea that will be discussed later on in this section. Taking a post-human position, my writing and practice are influenced by the ideas and philosophies of scholars and thinkers Katherine Hayles and Rosi Braidotti, and by Donna Haraway's cyborg philosophies and manifestos on the 'techno-body', as I explore my own and others' felt, moving, embodied experiences of VR technology. The ideas of all of these conceptual interlocutors are returned to in more depth in this second part of the chapter and intertwined within the practice-led writing of the following two chapters.

Ruth Zaporah, physical performer of improvisation, writes, "[w]hen I refer to the body, I am also referring to the mind, for the two are known through the other and are inseparable. The body knows itself through the mind, and the mind knows itself through the body (Zaporah 2003: 21). The participants of this research are invited to use somatic-dance and improvisation tools and practices to drop the activities of their minds into their bodies and into a realm of sensing and movement which extends, from the body, toward a relational engagement with the materiality of the world around. These practices open up possibilities for experiencing the ways in which body-minds are "constructed through the senses" (Manning 2007: 137) and "relationally inter-created in a field of prosthetic in(ter)vention" (Manning 2007: 137). Tuning to this embodied and relational awareness can offer a flexing of sensory attention. In processes of reconstructing the body-mind and redistributing awareness, there can be a reimagining and re-enlivening of the human and the non-human, the digital and the corporeal spaces of and beyond bodies.

Tim Ingold writes about 'the primacy of movement' and 'the relationality of being' as essential modes for humans in their ability to move in and sense the environment in which they are located (Ingold 2011). These modes are processes of continual becoming through

which human body-minds come to know the different facets of themselves and these relations. Dancers improvise attending to these processes through movement, their bodies not fixed in roles nor pre-positioned in time and space. “The body does not move into space and time, it creates space and time; there is no space and time before movement” (Manning 2007: xiii). It is “in the potential of listening to the breath, the body, the distance and closeness of another human being” (Manning 2007: 5), that new worlds are created.

The term ‘meshwork’ is borrowed from philosopher Henri Lefebvre by Ingold to describe the patterns or trails left by humans and animals “whose movements weave an environment” (Ingold 2016: 83). “There is no inside or outside, and no boundary separating” the body or organism and its environment (Ingold 2011: 88). The meshwork exists as the “trails along which life is lived” (Ingold 2016: 83) as a tangled weave of the world and its inhabitants continual becoming. Ingold writes that “[i]t is in the entanglement of lines, not in the connecting of points, that the mesh is constituted” (Ingold 2016: 83), and it is in the movement of these lines, as “trail[s] of movement or growth” (Ingold 2011: 88) creating turns and twists, folding and unfolding, crossing and knotting, that relations are created and lived.

> Every such trail discloses a relation. But the relation is not between one thing and another – between the organism ‘here’ and the environment ‘there’. It is rather a trail along which life is lived. Neither beginning here and ending there, nor vice versa, the trail winds through or amidst like the root of a plant or a stream between its banks. Each such trail is but one strand in a tissue of trails that together comprise the texture of the lifeworld. This texture is what I mean when I speak of organisms being constituted within a relational field. It is a field not of interconnected points but of interwoven lines; not a network but a meshwork. (Ingold 2011: 88)

Ingold’s meshwork of lines that are “wayfaring” (Ingold 2016: 78) offers a tangible sense of felt materiality in the spaces between bodies, and within bodies themselves, “[i]t is the very surface of the body that is dissolved, allowing the lines to penetrate its interiority” (Ingold 2016: 62). These ideas feed directly into dance improvisation practices which open up felt connections between bodies weaving invisible environments. The meshwork locates itself within and across the human and non-human world, a world which, writing on a vital materialism, Jane Bennett argues for a non-separation or hierarchical formation of. The non-

human, not beholden to or belonging to the human, but "lively and self-organizing" (Bennett 2010: 10) matter "rather than passive or mechanical means under the direction of something non-material, that is, an active soul or mind" (Bennett 2010: 10). Bennett draws on Spinoza's *Conatus* to ascribe *all* bodies, human and non-human, to an inherent vitality, a vitality present within the weave of the meshwork, every human and non-human movement or trail constituting the whole through lively and active participation. Bennett writes that "every non-human body shares with every human body a conative nature (and thus a virtue appropriate to its material configuration)" (Bennett 2010: 2), adding that humans too are constituted in part as non-human (Bennett 2010: 4). Bennett interrogates the ways in which human and non-human forces and materialities combine and interact with and upon each other forming dynamic assemblages, and these forces "enhance their power" (Bennett 2010: 23) through their distributed relations, rather than "localized within the human body or produced only through human efforts" (Bennett 2010: 23). This vital materialism is necessitated in dance practices. As Zaporah writes, "I sense the body as no different than the space it is moving in and the sound it is moving to. If I am improvising with a partner, each of our bodies becomes an extension of the other. I perceive her body as no other than my own" (Zaporah 2003: 23). This extension and distribution of agency is felt or sensed as "a collecting force, a softening of the hard edges that separate one person from another, an activity of communion" (Zaporah 2003: 23).

Technologies are also non-human and have become increasingly part of the connective fabric or "meshwork" (Ingold 2016: 83) of the "lifeworld" (Idhe 1990) of humans and environment, constituting part of its "weave and texture" (Ingold 2016: 83). Distinct from the natural world, technologies open up new territories for participation and for assembling as human and non-human relations. My research, influenced by these ideas, delves into an experiential sensing of these body-technology relations and assemblages. Don Ihde, taking a post-phenomenological perspective, outlines different perceived relations between humans, technologies and the environment, a "phenomenology of technics" (Ihde 1990: 73). In his work, he centres "upon the ways we are bodily engaged with technologies" (Ihde 1990: 73), the ways in which "I-as-body interact with my environment by means of technologies" (Ihde 1990: 73). Technologies, across these relations, change in their transparency, in their mediation between body and environment. "My glasses", an optical technology, "become part of the way I ordinarily experience my surroundings" (Ihde 1990: 74); they are "barely noticed, if at all" (Ihde 1990: 74). Similarly, the "hearing aid does this for hearing, and the

blind man's cane for tactile motility" (Ihde 1990: 74). These relations are, for Idhe, embodied, the body extends (or reduces) to the parameters of the technology, "[t]he experience of one's body image is not fixed but malleably extendable and/or reducible in terms of the material or technological mediations that may be embodied" (Ihde 1990: 75). The body and technology are in a transparent alliance toward an engagement with the environment. The body-technology relations of participants in this research shift from their experience of VR technology as a physical and material form, noticed through the weight of the headset, the connecting wires, and the touch to the controllers; to an invisible, unfelt mediator of the simulated environment.

Possibilities for extended and distributed thought, action, perception and embodiment are created with the body's assembling with technologies, through an outward amplification, an exteriorization of the human. These relations are actively reciprocated within the body, affecting intrinsic physiological and psychological processes – re-programming and embedding specific organisations or constructions of perception and embodiment. There is a "slip-sliding" (Bennett 2010) of one into the other as "infoldings of the flesh" (Haraway 2006: 2), where flesh is, as Merleau-Ponty writes, both human and non-human. "The flesh (of the world or my own)" (Merleau-Ponty 1968: 146) which "forms me" (Merleau-Ponty 1968: 140) and "traverses me" (Merleau-Ponty 1968: 140) as visible and invisible, matter and non-matter, and that also "can traverse, animate other bodies" (Merleau-Ponty 1968: 140). The "reciprocal insertion and intertwining of one in the other" (Merleau-Ponty 1968: 138) traverses superficial borders between human/body and 'other', as technology permeates body and environment, "there is no need to pierce, cut, ingest or extract in order to achieve a state of closeness or integration: we are already inside out, already porous, already one flesh" (Kozel 2007: 270). Technologies are "not mediations, something in between us and another bit of the world. Rather, technologies are organs, full partners" (Haraway 2006: 2). Technologies seamlessly enter into and become part of what it is to be human, the non-human of the human, "our own constitution as vital materiality" (Bennett 2010: 10). and "human power is itself a kind of thing-power" (Bennett 2010: 10). Humans are composed of various material parts, but a crucial and more challenging point, as Bennett argues, is "to conceive of these materials as lively and self-organising, rather than as passive or mechanical means under the direction of something non-material, that is, an active soul or mind" (Bennett 2010: 10).

Human attention is directed by technology, with little awareness of this re-direction occurring, resulting in a loss of sensory agency and ultimately a reduction of sensory flexibility, the ability to sense synaesthetically. This passivity is challenged in a call to attentional sensing through practice-based investigations in this research. Speaking in *The Social Dilemma* (2020 Netflix documentary), innovator Tristan Harris argues that technologies are designed with human attention as the central currency, that attention creates the possibility to extract more data, thus fed back to the individual and demanding of more attention. Sherry Turkle writes, "in the 1960s, through the 1980s, debates about artificial intelligence centred on the question of whether machines could 'really' be intelligent. These discussions were about the objects themselves, what they could and could not do" (Turkle 2003). She asserts a case that "technology is [becoming] not only ubiquitous but has become highly intrusive as well" (Turkle 2003). Human encounters with technologies "provoke responses that are not about these machines' capabilities but our vulnerabilities" (Turkle 2011: 20). Harris, similarly, is of the opinion that "[t]he danger point is when computers can overpower our weaknesses when algorithms can sense our emotional vulnerabilities and exploit them for profit" (Harris 2019).

In the early days of VR in the 1970s and 1980s, the cyberculture of internet and video games influenced by such writing as William Gibson's *Neuromancer* and "his alluring fantasy of 'meatless' subjects incorporated into a computer" (Lahti 2003: 157), opened up "a division between an inert body that is left behind and a disembodied subjectivity that inhabits the virtual realm" (Hayles 1999: 290) in which the human subject becomes "an autonomous self with unambiguous borders" (Hayles 1999: 290). Hayles lays out the post-human position as a means by which to "offer resources" (Hayles 1999: 290) to what Haraway describes as "deepened dualisms" (2016): the engagement with technology not "a question of leaving the body behind but rather of extending embodied awareness in highly specific, local, and material ways" (Hayles 1999: 291), extending, not limiting, humanity. This research advocates for an active participation in technology which "locates the subject in the flow of relations with multiple [human and non-human] others" (Braidotti 2013: 50) toward an "expanding of life toward the non-human" (Braidotti 2013: 50), rather than restricting or limiting this flow.

A more conscious awareness of the exchange between the body and technology is required, an experiencing of what constitutes the "commitment" (Haraway 2006: 1) of this exchange,

"[i]nsofar as I use or employ a technology, I am used by and employed by that technology as well" (Haraway 2006: 1). By inviting active participation, in which there is an awakening of sensory and bodily awareness, this research challenges notions of technology as dominant over or dominating the body. Robert Switzer argues that VR "furthers the project of Cartesian metaphysics – the domination of nature and of our own bodies" (Switzer 1997: 507), building on "the metaphysical fantasy of total comprehension and control – an old dream with new power and new dangers in the hands of a new elite of magician-programmers" (Switzer 1997: 507). He writes, "Our lives are already being shaped – as in the near future they may be dominated- by the fastest-growing new technology in history: Virtual Reality" (Switzer 1997: 507).

> The technological domination of the 'real' represents a victory of abstracting and, seemingly disembodied, intelligence over a more corporeal and elemental engagement in what is. The physical bodies that constitute our world, and our own involved and empowered bodies, have been virtually overwritten by symbolic representations, by relational formulations and equivalences – by code. (Switzer 1997: 507)

This process of technological dominance is also considered by Frank Biocca:

> We tend to think of technology as something alien, not a reflection of ourselves. It may well be that the human brain and body evolved to fully inhabit these externalizations of mental processes and amplifications of the body that are our technologies. (Biocca 1997)

Biocca considers the ways in which technology increasingly permeates human life as a progressive embodiment, a "tighter coupling of the body to the interface. The body is becoming present in both physical space and cyberspace. The interface is adapting to the body; the body is adapting to the interface" (Biocca 1997). This process is considered by Biocca as "a larger pattern, the cultural evolution of humans and communication artifacts towards a mutual integration and greater 'somatic flexibility'" (Biocca 1997). The somatic flexibility referred to here is a term drawn by Biocca from Gregory Bateson (1972) and is not about the agential flexibility of human attention, as specified in the training and tuning practices of dancers, but as a conceptual aspect of evolution. What becomes clear in the ideas

raised by Switzer and Biocca – of a body that is overwritten by code and of a body progressively somatically tuned toward technological dependence – is that computers are becoming livelier whilst humans are becoming more inert (Haraway 1985). An inert or passive body is made lively, activated through practices of this research that tune into a sensorial and bodily awareness in participation with VR technology.

Lanier writes that VR will not achieve "complete coverage of all the human senses or measurement of everything there is to be measured from a person" (Lanier 2017: 49). VR as a technology that never replaces the physical body or world is, as Baudrillard writes, "pretending or dissimulating, [and] leaves the principle of reality intact: the difference is always clear" (Baudrillard 1981: 3). The "chase toward an ultimate destination" (Lanier 2017: 49), toward a complete simulacrum which "threaten[s] the difference between the 'true' and the 'false', the 'real' and the 'imaginary'" (Baudrillard 1981: 3), "can probably never be reached" (Lanier 2017: 49). Instead, and in alignment with my own considerations of the development of VR, Lanier considers that this technology simulates a coarser reality (Lanier 2017: 50), and thus "fosters an appreciation of the depth of physical reality in comparison" (Lanier 2017: 50). In my research, the sensorial body is forefronted, attended to as a fluid and dynamic system, as a living entity, an "analog" (Massumi 2002), through which all experience moves, "[y]ou are still there, at the centre, experiencing whatever is present" (Lanier 2017: 55). Taking this approach, VR technology can expose perceptual and embodied traits and invite possibilities for movement and exploration of simulated virtuality and distributed corporeality as a body and within the senses.

Bodies that become livelier in an active, not passive, participation with technologies, opens up the question of responsibility – distributed across bodies and machines - and challenges the ways in which technologies mediate and expend the body, creating the potential for future humans as "compliant subjects" (Jones 2006: 43). Jones asks, "how alert we can be?" (Jones 2006: 43), according to Hayles, "it is now apparent that humans and technical systems are engaged in complex symbiotic relationships, in which each symbiont brings characteristic advantages and limitations to the relationship. The more such symbiosis advances, the more difficult it will be for either symbiont to flourish without the other" (Hayles 2017: 216). Bodies are becoming technological, producing "an amplified, connected, expanded but also disequilibrated corporeality – a new sensorium" (Jones 2006: 2), and this sensorium is "shifting, contingent, dynamic, and alive. It lives only in us and through us, enhanced by our

technologies" (Jones 2006: 8). These technologies continue the prioritization of vision, the ocular, pushing the "other senses to the periphery" (Jones 2006: 8). These dominant sensory patterns are experienced and challenged through the participatory investigation of this research, which posits a counterpoint mode of presence to the visual. Schiphorst, Loke and Höök write about experience as a "pliable material" (Schiphorst, Loke and Höök 2020: 2), which can be operated through "the skills of attention" (Schiphorst, Loke and Höök, 2020; 2). They argue that this "causal relationship between attention and experience" (Schiphorst, Loke and Höök 2020: 2) is transformative, that it "transforms the material qualities of experience" (Schiphorst, Loke and Höök 2020: 2). Technologies "implicitly or explicitly require and even demand our human attention" (Schiphorst, Loke and Höök 2020: 2). For practices that reveal attentional biases and open up choices, the ability to move attention are key in order to challenge or question the current status quo. The attentional practices of this research are drawn from dance and offer participants, in their engagement with VR technology, the opportunity to challenge their own "characteristic advantages and limitations" (Hayles 2017) and open up a wider potential for sensing and movement, and for what a body can be.

Method and Layout of Chapters

The central research questions, as laid out in the introduction, are initiated by my own experience of VR and the perception gap. I have followed my experience of VR and opened out my practice – in bringing a dance sensibility together with VR – to others through designing and crafting participatory workshops and performances. Through these participatory processes of re-tuning sensory awareness in VR, there is an investigation into and a sharing of experiences, which, from the basis of the perception gap, open up notions of expanded sensing and perception. The practice follows the sequencing of the research questions: of how to invite an activation within the senses in the body's engagement with VR technology away from the status quo of visual dominance; the potential of the recall of this shift as an attentional practice through which there can be a transformation of relations between the human and non-human world – as relations which become felt, embodied, responsive and resilient; the ethical concerns that move along with and through the practice, and how the practice responds to and through these concerns.

There are two modes of practice-as-research, constituted as four practical elements – two workshops and two performances. The workshops combine somatic-dance practices and multi-person VR technology to investigate the perception gap amongst different groups, and the participatory performance works, *Figuring* and *Soma,* draw directly from the insights and learning gathered from the workshops, building on the themes and raising further questions. These four practical elements are critically discussed and reflected on in the next two chapters: the two sets of workshops detailed in Chapter Two and the participatory performances, *Figuring* and *Soma,* detailed in Chapter Three. These two chapters build on the argument and research questions laid out in the opening of this introductory chapter and critically frame and reflect on the practices that have been undertaken. There is equal weighting of the practice - evidenced through four edited films, which draw from extensive audio and video documentation of the workshops and performances - and the written, theoretical element of this practice-as-research project. It is important to emphasise that this is a project grounded in the 'doing' of the practice and the contribution to knowledge has arisen through this doing. The theoretical concepts, ideas and questions that are discussed in the writing, drawn from theorists and artistic comparators, have fed into – challenging and extending - the practice in an iterative dialogue between ideas and physicality. This process and relationship enable, as Simon Jones writes, a "being able to look askance at my practice from this perspective of outside-thinking as respite and refreshment helps me to understand differently what I am doing in the middle of working" (Jones 2017: 6).

Chapter Two frames and discusses the first set of practices – two sets of workshops: *Ways of Seeing* (*WOS*) workshops at the *Bodily Undoing* symposium at Bath Spa University, which took place in September 2017 with groups of somatic-dance practitioners, and *The Felt Sense* (*TFS*) workshops, which took place at Knowle West Media Centre in July 2018 with groups of public participants. This chapter focuses on the key themes to emerge from these participatory workshops which I have used to develop participatory performances with VR.

Chapter Three details and critically frames the participatory performances *Figuring* (2018) and *Soma* (2019), which embed and craft somatic-dance practices as a three-part participatory journey with multi-person VR. The design and sequencing of this journey are discussed, alongside critical issues of care, agency and touch, which are activated and considered through a dance-based lens. This research articulates the need for participatory performance practices, which involve immersive technologies such as VR, to counter dominant normative

conventions in body-technology relations. It brings a dancerly voice into the conversation on the design and use of VR (and other technologies). The thesis concludes by outlining the key achievements and contributions of this research and offers recommendations for further research, which takes root in the ideas and practices developed here for dance as a participatory, immersive and digital performance, and the application of these ideas and practices across non-arts-based fields of knowledge, e.g. HCI, psychology and the social sciences.

During the time that I have been working on this research project (a journey that began in January 2017), my own experience of VR has been drawn on autoethnographically, alongside testimonies from the research participants. These accounts and testimonies have fed into the development of the practice described and critically framed in the next two chapters and are used to evidence and support my argument. I have taken an auto-ethnographic approach to attend to and write directly on my experiences over the course of the research project. These accounts mostly drew on specific moments which had an emotional or affective resonance for me: for example, writing in response to physical events, studio practice, and literature. This research project is predicated on my encounter with VR - and the auto-ethnographic writing brings my experience, and my body into the discussion. I have included two auto-ethnographic accounts in this writing, which connect my personal, affective experiences with those of the participants, and with the ideas and theories of other artists and scholars. Sociologist and practitioner-researcher of occupational therapy, Sally Denshire writes about the role of auto-ethnography in her work and field, foregrounding "the social relationships and responsibilities that may have implications for everyone identified" (Denshire 2014: 832). She discusses "the social implications of telling a story from more than one point of view" (Denshire 2014: 833), specifically the "scope" (Denshire 2014: 833) of this storytelling from "previously silenced authors" (Denshire 2014: 833). She writes of the importance of "writing body-selves back into auto-ethnographic accounts" (Denshire 2014: 844), though she describes this as being "difficult to accomplish when lived bodies have been strangely absent" (Denshire 2014: 844) from her field of "healthcare research" (Denshire 2014: 845). My writing comes from the body, drawing on my dance practice as a means to understand and communicate experiences. These are processes which, dance scholar, Jane Bacon explores and articulates in her own research. Using "somatic practices as methodological imperative or praxis for arts research" (Bacon 2010: 63), there "comes a bodily knowing – a felt sense, a feeling tone – that is like no other and is the point from which many practice-led

researchers in movement-based realms find the voice of her body" (Bacon 2010: 63). I also write on the experiences of others, using critical ethnography as a ground from which to articulate participant testimonies. This approach, as - critical ethnographer - D. Soyini Maddison writes, "begins with an ethical responsibility" (Madison 2005: 5). "The critical ethnographer [also] takes us beneath surface appearances, disrupts the *status quo*, and unsettles both neutrality and taken-for-granted assumptions" (Madison 2005: 5).

Using the lenses of phenomenology and micro-phenomenology, I pull out and bring attention to participant experiences of bodily and sensorial movement. Taking a micro-phenomenological approach, Michael Kimmel analyses the ways in which partner dancers sense and move in response to one another in the improvisational practice of tango. He uses this approach to investigate the "dynamic sensing" (Kimmel 2013: 76) that occurs between these bodies in motion, and the role played by their embodied and sensory training. I have connected into the micro-detail of my own sensorial and bodily engagement with VR technology, and I have used these sensibilities to unpack the experiences of others in my writing.

Participant data was acquired using different processes throughout the research journey. For the workshops discussed in Chapter Two, data was collected as audio recordings of group discussions in each of the practical workshop sessions; a spreadsheet was created for the mark-making sessions in *TFS* workshops, and still images and video footage for each workshop session was captured. For the participatory performances, qualitative participant feedback from *Figuring* was gathered using audio-recorded prompted group discussions, capturing immediate reflections after the experience; one-to-one approximately one-hour long interviews with the participants, which took place 1-3 months following the experience/event; recorded focus group sessions for *Soma*, held at Bristol Old Vic and captured as audio, stills and video footage; and extensive video, photography, audio and written/drawn materials collected from the creative studio processes for both *Figuring* and *Soma.* The key conversations and discussions used to evidence this thesis, specifically the group discussions from the workshops, the mark-making data from the *TFS* workshops, and all of the participant discussions from *Figuring* and *Soma,* have been transcribed, either by me or by a transcription service (Bristol Transcription Service).

Having collected the research data, when it came to processing it, I explored different methodologies for analysis. I initially approached the data using a science-based method, typically employed in the field of HCI. Specifically, I analysed the transcribed data (of the two sets of workshop discussions, and *Figuring* one-to-one interviews and prompted discussions) drawing on the thematic analysis (TA) approach, outlined by Braun and Clarke (2006). Braun and Clark's approach is a "widely used qualitative analytic method within psychology" (Braun and Clarke 2006: 77) for "identifying, analysing and reporting on patterns (or themes) within data" (Braun and Clarke 2006: 79). The authors state that the process of TA "provides accessible and systematic procedures for generating codes and themes from qualitative data" (Clarke and Braun 2015: 2). Following this process, I coded all of the participant's comments, a process of fragmenting and abstracting the data into the "building blocks for themes (larger) patterns of meaning, underpinned by a central organising concept; a shared core idea" (Clarke and Braun 2015: 2).

According to Braun and Clarke, the themes that emerge in TA enable a "framework for organising and reporting on the researcher's analytic observations" (Clarke and Braun 2015: 2). In my experience of undertaking this process, I found that I had already intuited many of the themes before they had emerged as patterns in the data – through my own lived experiences of the workshops and performances, the subsequent discussions and interviews (as co-present body, witness, facilitator and interviewer); and through my reflective thinking and writing on the events. As the process of coding and pattern analysis continued, the TA method began to take me away from the practice and the body, disconnecting me from the individual experiences of the participants and their moving sensing bodies. The TA method arrives at a population-level account of the data, because it is focussed on users or participants as groups. This focus was unsatisfactory to me, as a dance practitioner and maker, as it did not go deeply enough into the individual's felt sense of the experience. Towards the end of the process, of applying the TA method to *Figuring* participant feedback, during the development of *Soma*, I resolved this tension - between the TA method and a more intuitive, practice-led approach. During the creative process for *Soma* - I brought the words of participants physically into the studio (on large sheets of paper), using the participants' words to create physical practices with and for the dancers. At this time, I reverted to fully employing a critical ethnographic approach, as a grounding lens from which to write, and to help me think through the thematics that had emerged from the coding process. This enabled me to let the participants' words inform the practice and to pull out what felt intuitively

important and relevant to the research questions. As I brought my body and sensory standpoint to the fore in unpacking, moving and writing on the participants' words, I recognised my own perspective, biases, and limitations in the framing of their experiences.

Chapter 2: *Ways of Seeing* and *The Felt Sense* Workshops

Please view the documentation of the *Ways of Seeing and The Felt Sense workshops* before reading on. These have been created with film-maker Nina Ross to evidence and communicate the workshop practices, specifically detailing the sequencing of tasks in each workshop.

Introduction

This research project is based on my dancerly response to VR technology and to the demands the technology makes in terms of requiring a sensing and bodily engagement which is visually driven. The visual emphasis of the technology disconnects my own sensibilities of connection with body and world, and there becomes a disagreement, a discrepancy, which is in play between physical and virtual worlds, a perception gap between seeing and feeling. The workshop practices shifted the investigation of my own experience with the technology to that of others and toward experiences that were shared using a multi-person VR framework in which participants were able to be co-present across physical and virtual environments. This chapter deals specifically with the two sets of workshops that I designed and delivered for this research. These workshops opened out my bodily and sensorial experiences by gathering insight into other participatory experiences of VR, providing an opportunity to sketch and test out different participant pathways into and out of VR, and helping me in thinking through and practising approaches to creating participatory performance work.

By combining somatic-dance practices and multi-person VR technology, I designed and crafted the two sets of workshops specifically in order to explore the perception gap between seeing and feeling. I wanted to explore how the layers of perceptual information that are simultaneously received from physical and virtual environments are attended to by different people and how it might be possible to create specific situations in which the perception gap is more exposed. The *seen* and the *felt*, the senses of sight and touch, are complex and interconnected together within a larger sensing framework – the human sensory system. In conceptualizing the workshops, I split up these senses, each assuming the focus of one set of workshops, exploring seeing in the *Ways of Seeing* (*WOS*) workshops, and feeling in *TFS* workshops. Whilst this split is a superficial distinction between the senses, it supported a process of breaking down and problematizing the complex issues around the sensory body in

VR. I led the first set of workshops as part of the *Bodily Undoing* symposium at Bath Spa University (2018) with groups of somatic-dance practitioners. The *WOS* workshops explored the expanded sensibilities of seeing in VR and in somatic-dance practices across physical and virtual, seen and unseen environments. I ran the second set of workshops at Knowle West Media Centre (2018) with public participants. Titled *The Felt Sense,* these workshops explored expanded notions of touch as a tactile or felt sensing which operated beyond bodies and in spaces absent of any physical contact.

In this first part of this chapter, I will introduce the workshops in more detail, describing the specific sequencing of activities and tasks. Following on from this, in the second part of this chapter, I will unpack and discuss the way in which the senses of vision and touch are dealt with; firstly, in a typical engagement with VR technology and secondly, in somatic and improvisation practices in dance. I discuss how the perception gap within a VE is usually concealed in VR designs and practices and how it is uncovered and can be sustained in processes of somatic-dance sensing in an engagement with the technology. Bringing together these approaches to the senses and their issues in dance and VR sets up the context for the workshops, which explore the sensations and experiences of the perception gap across the different participant groups. In the last part of this chapter, I will outline and critically discuss some of the key thematic findings from the workshops, which I build on in choreographic processes and the design of participatory performances *Figuring* and *Soma*, written about in Chapter 3.

Part One: The Workshops

Participatory workshops *Ways of Seeing* and *The Felt Sense* investigated the 'seen' and the 'felt' across shared and interactive physical, virtual and imagined environments. Through both sets of workshops, as well as the associated labs and residencies I have undertaken since I first put my head in a VR headset back in 2016, I have led many people on journeys into and out of VR. In the design of these workshops, I wanted to consider the VE as one aspect of a wider experiential and somatic-based journey, not as the sole element of the experience. These journeys have been crafted using somatic and improvisation practices in dance, designing sequences of activity that invite shifts in sensory attention, perception and embodiment. These practices challenge normative visually dominant modes of perception and the notion of a VE as a space to 'escape' to. The technology as a tool or means through

which to explore the presence of and relations between the human and non-human bodies and entities across physical and virtual realms. The pre- and post-VR practices of tuning and tooling participants toward somatic sensibilities and sensory flexibility opened up their experiences of the VE, expanded sensing and the perception gap.

The first set of workshops that I write about in this chapter, *WOS*, were influenced by extensive observations of different participants in their encounters with VR technology at a range of different events (between January–July 2017, see Appendix 1 for more details on these events). These participants included scientists and engineers (from the University of Bristol); public groups of participants (taking part in the interactive VR installation at We The Curious science centre in Bristol and Modern Art Oxford); and a select group of dancers who applied to take part in a series of 'dancer labs' as part of an artist residency at the Arnolfini contemporary art gallery in Bristol (2017, see Figure 2). Through these participatory events, I had noticed a difference in the ways in which the dancers attended to their presence in the VE compared to the other (non-dancer) participants. For example, the dancer responses during the Arnolfini labs were based on the ways in which they, as a result of their somatic (first-person, bodily) sensibilities, experienced their bodies as unseen in the VE.

Figure 2: dancer labs at Arnolfini (March 2017)

The dancers at Arnolfini communicated sensations of a tension between their physical felt body and environment and the visual VE, which tallied with my own experiences of being in a VE. In contrast, the groups of non-dancer participants that I had observed and talked to at

different events, once in the VE, did not appear to connect with their bodies as unseen. Instead, they seemed to lose or forget their bodies, and their physical presence, in favour of a VE in which they did not have a (visual) body. I wanted to investigate more deeply these differing perspectives, of different experiences of the body in a VE. The *WOS* workshops, carried out as part of the *Bodily Undoing* Symposium at Bath Spa University (September 2017) "to address the socially and cultural transformative potential of somatics and transdisciplinary performance practices" (Kampe 2017), were designed and delivered as a means by which to initiate this process. Locating the workshops at this event, with participants who were practitioners, artists and scholars who work with somatic practices within the field of dance (though the participants had little knowledge or previous experience in VR), enabled me to unpack the dancer's responses to VR technology and to being in a VE I had previously witnessed at the dancer labs at Arnolfini.

There were two *WOS* workshops (each one-hour long) with twelve participants taking part in total (six per workshop). The workshops consisted of a 40-minute practical session in which the participants were invited to engage in a series of practices inviting them to take a somatic sensory focus in experiencing VR technology (see Appendix 2 for details on the task descriptors and sequencing). These practices emphasised the notion of 'seeing' as an embodied and tactile sense and as a sense which could operate in the dark and from different body parts. The participants explored expanded practices of seeing across physical and virtual, visual and non-visual environments and toward the human and non-human bodies within these environments. These workshop practices of sensing the body and environment - as both physical and virtual, seen and unseen - enabled an investigation of the perception gap. Specifically, a blindfolded practice was used to tune up the felt sensibilities of the body and the use of touch to connect to the physical environment and to the other bodies within that environment. In the VE, the participants could subsequently draw from this tuning process to explore the relationship between a dance-based felt mode of sensing and the visuality of the VE. The participants were invited to explore the gaps and crossings between the physical and the virtual, through talking, moving, and sensing together. The participants worked in partners as guides and witnesses for each other - one body housed within the VE, the other outside of the technology, located in the physical space (see *WOS* video-document at timecode: 1:49-1:57). The practical workshop sessions were followed by an open and prompted group discussion, in which participants were invited to share their responses and reflections on what they had experienced. They were asked to describe how they felt, sensed

and moved in each of the activities and the physical, somatic, and sensory qualities of their body, other bodies and the environments they moved through.

Figure 3: WOS workshops, Bodily Undoing Symposium, Bath Spa University, 2017

Figure 4: WOS workshops, Bodily Undoing Symposium, Bath Spa University, 2017

The participant's experiences of expanded modes of 'seeing' in *WOS* workshops, i.e. 'seeing' in the darkness of the blindfold and 'seeing' within and across the physical and virtual domains within the HMD, brought up for them expanded sensations of touch. They experienced touch not just from the direct physical contact to the environment: to the floor, the walls, the technology, and to other bodies, but also to the virtual entities within the VE (as pseudo-haptic experiences). The second set of workshops, *TFS*, were built on these expanded touch-based experiences and designed to further explore the haptic realm of VR technology. In designing the workshops, I drew from my own experiences of touch through dance practices, which operates in the spaces beyond the body, beyond a physical skin-to-skin or surface-to-surface contact. I drew from my own embodied experiences to facilitate the workshops in guiding and supporting the non-dancer participants toward these expanded touch sensations as more nuanced phenomenal sensations across the physical environment,

the VE, and their imaginations. The practices, format and sequencing design for *TFS* workshops were tested with Bath Spa University dance students (March 2018) and, in part, at Coventry University's *Digital Echoes* symposium with a range of dance practitioners, artists and academics (April 2018). *TFS* workshops were then offered to public participants in July 2018 at Knowle West Media Centre in Bristol, engaging with the centre's staff and the local community as participants.

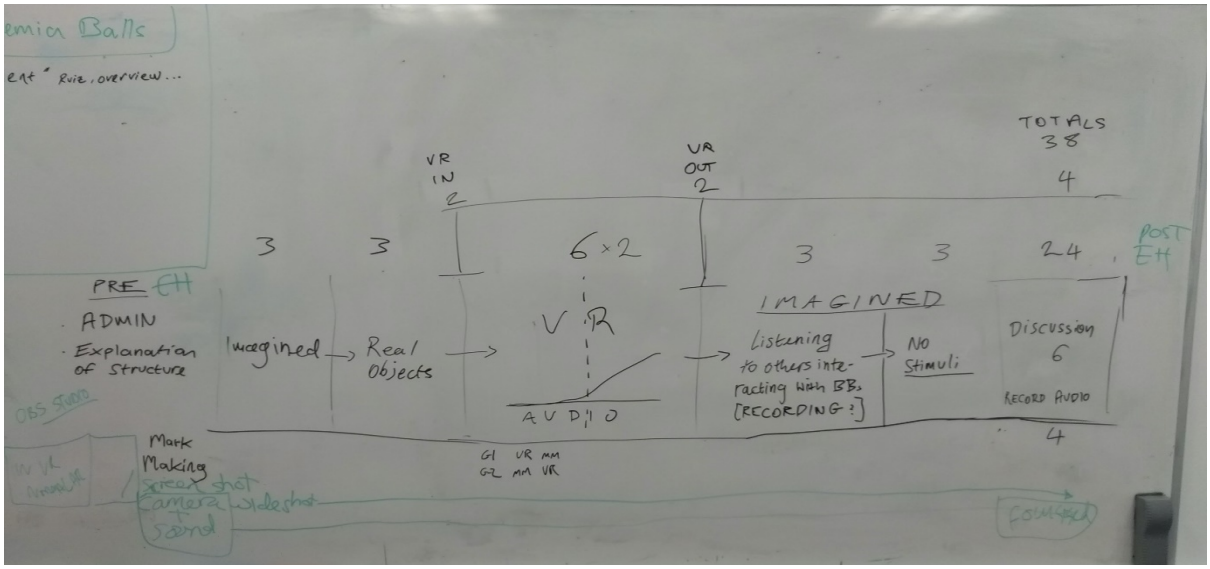


Figure 5: workshop sequencing planning with Alex Jones and Helen Deeks (UoB PhD researchers)

In *TFS* workshops, sensorial practices, less focused on the relations between bodies, emphasised the sensation of touch to physical, virtual and imagined phenomena. The workshops involved a sequence of tasks that moved the participant's experience of a ball-like entity through processes of transformation between physical, virtual and imagined states of presence. A significant aspect of the study design involved a specific ordering of these tasks to enable the participant experience to build, through the workshop journey, a more nuanced experiential understanding of touch. Marcyrose Chvasta, Assistant Professor in performance, cultural and media studies in the Department of Communication at the University of South Florida, details Philosopher Pierre Lévy's interest in virtualization as a process which operates in reverse to actualization (Chvasta 2005): The process of actualization as that which moves from a virtual problem to a physical/actual solution, whereas virtualization moves from a physical/actual solution to exploring new virtual territory – a new problem (which can, in turn, be actualized). These philosophical ideas supported and extended my practice, in processes of devising the sequencing of the touch - from physical to virtual - experienced by

TFS participants and the processes of "movement or transformation that continually exists between them" (Chvasta 2005: 165).

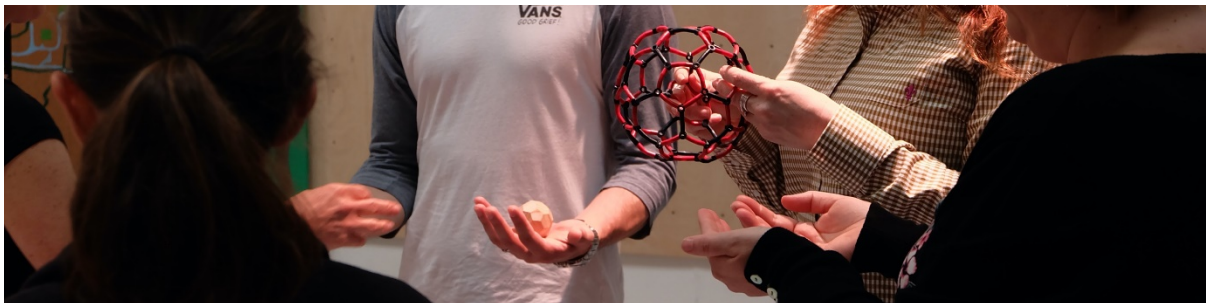


Figure 6: TFS workshops, task 1 – Knowle West Media Centre, 2018

Figure 7: TFS workshops, task 2 – Knowle West Media Centre, 2018

Figure 8: TFS workshops, tasks 3, 4 and 5 – Knowle West Media Centre, 2018

Different states of presence and materiality are journeyed through by participants in *TFS* workshops, through the sequencing of tasks across six sensing stages: task one – physical; task two – imagined; task three – sounded-virtual; task four – visual virtual; task five – virtual and sounded; and finally, task six – reimagined (see Appendix 2 for details on the task descriptors and sequencing). Biocca asserts that, at any one point in time, a participant in a VE "can be said to feel as if they are physically present in only one of three places: the

physical environment, the virtual environment, or the imaginal environment" (Biocca 1997) and that "[p]resence oscillates among these three poles" (Biocca 1997). The sequenced design of the workshops provided a framework that guided the participants toward somatic and tactile modes of sensing prior to entering into the VE, supporting an opening to these sensibilities whilst using the technology. The physical balls grounded the experience in physical and material touch, from which the notion of a ball could come into being virtually in the participant's imaginations. The participants were then introduced to the virtual balls of the VE, first through sound only, interacting with the sonification of the virtual balls using the VR controllers to move and interact with them, then interacting with the visual virtual balls within the HMD, and then with both visual and sound elements combined.

Figure 9: TFS workshops, task 6 – Knowle West Media Centre, 2018

The final stage of the sequence was an invitation to the participants to 'reimagine' the balls, repeating the second task to explore what might have changed through their experience of and sensory engagement within the VE. After each task, there was time for participants to write/draw/mark their immediate responses (mark-making) (see *TFS* video-document at timecode: 1:16-1:20), and at the end of the workshop session, a ten-minute discussion in which participants were invited to respond to a series of questions about their experience (see Appendix 2 for the list of questions used as prompts for the discussions). As with the *WOS* workshops, *TFS* workshop discussions were audio-recorded, and the practical sessions were video-recorded. In *TFS* workshops, video footage was recorded in both the physical environment and from within the VE (internal VE footage was recorded using software called

OBS Studio, used by researcher Helen Deeks, something I was not yet able to do in the *WOS* workshops).

In both sets of workshops, the commercial *HTC Vive Pro* VR technology was used (see Figure 10). A multi-person framework for this technology, in which multiple participants are co-present across both physical and virtual environments and are able to see each other, move and interact within a shared VE, was developed for specific science-based applications at the University of Bristol (UoB). The framework operates as a system that scientists can use to interact with molecular-dynamic processes based on computational data running in real-time in a three-dimensional environment (Connor *et al.* 2018). The technology and this molecular science-based framework were accessed for use in this research through a collaboration with the Intangible Realities Laboratory (IRL), led by Dr David Glowacki, a computational scientist in the Chemistry department at the University of Bristol. The VEs presented to the participants in each of the two sets of workshops included the molecular forms within them, as virtual and dynamic 'objects' with which the participants interacted. In the *WOS* workshops, these were 'air molecules', and in *TFS* workshops, 'carbon molecules' (also known colloquially within the science community as *Buckyballs*). The smaller and more gentle air molecules, whilst interactive in the VE, constituted – in the participant experience and invitations/tasks – part of the 'air' of the environment of the VE. The larger, more 'energetic' carbon molecules in the VEs in *TFS* workshops were specific virtual entities ('balls') with which the participants interacted as part of the workshop tasks. Whilst the framework was specifically developed with science users in mind, it is in the application of this multi-person VR technology, in combination with dance-based practices – rather than in its molecular content –that takes the focus of this research. It is the sensory experiences of the participants and their encounters of bodies and environments across physical and virtual worlds in assembling with the technology that is investigated, rather than their specific interactions with the dynamic molecular forms simulated in the VE. In each workshop, up to four participants were able to enter into and share the VE at one time. The VR headsets were tethered with thick wires to large laptops situated on a table at one end of the workshop space, each with approximately 3m of reach. The two lighthouse cameras were positioned diagonally opposite one another in corners of the space to track the movements and position of the embedded sensors in the VR headsets. Participants held a VR controller in each hand which they were able to use to interact with the molecular forms in the VE.

Figure 10: HTC Vive Pro VR technology taken from vive.com website

In the second part of this chapter, I discuss and theorise on the different ways in which dancers and technologists think and practice the senses, and how these resonate in certain modes of embodiment and perception - which connect or collide with the affordances of (VR) technology.

Part Two: Vision and Touch in VR and Dance

Concealing the Perception Gap in VR Experience Design

As discussed in Chapter One, VR technology is a visual medium and, in order to be effective, requires visual information to drive the senses to create the illusion of presence within a VE. The sense of the physical body being situated within a physical environment, which are both unseen whilst in a VE, are backgrounded in the experience. A participant's "presence in the virtual environment can be interrupted by sensory cues from the physical environment and imperfections in the interface" (Biocca 1997), interruptions which VR developers and designers seek to overcome as quickly as possible in order to get on with the experience. For example, in any VR experience, there can be moments in which the visual VE is disrupted, and the body's connection and relationship with the physical environment momentarily re-emerge. These moments can occur because of issues within the VE, e.g. around image quality or latency, or they can come from the physical world, e.g. if the participant accidentally bumps into something or someone, or there is or a physical event such as a door opening or someone entering the room, a breeze, etc. – unseen phenomena which are not mapped into the experience (visually). These moments bring a conscious awareness to the physical body and its located-ness in the physical environment, the presence of others within or the features of that environment, and the material presence of the technology.

> I consider and experience my body as a malleable, porous and relational entity, and my practice enables me to connect to the materiality of the human and non-human

> world around and within me as a tactile field of attention. The experience of my own body in the VE is, much of the time, at tension or at odds with the visual environment seen through the HMD. There are moments of feeling connected to the VE in which I can drop away, to some extent, from the physical world around me. At other times, I feel completely disconnected from both physical and virtual realms. Dropping into the visuality of the VE can take me into expanded sensory domains and into a 'felt' sensing of the virtual of the VE. A disconnect between the VE and my awareness of the physical sensory environment – which I am still present within – arises in these moments of tuning into the touch and tactility of the virtual world. The shifting relations between my body and the environment mediated through my senses and the technology are apparent. In the moments of 'full immersion', a giving over of my body to the technology – in the way that the technology has been designed for, arises a deep sense of 'trouble' within me. My body simultaneously moves into its extension within the VE and pulls away from it. (Thomas, autoethnographic writing)

Biocca writes that a virtual body "can significantly distort the [physical] body" (Biocca 1997), and the impact of this can result in the body getting out of sync with itself; "the virtual body competes with the physical body to influence the form of the phenomenal body. The result is a tug of war where the body schema may oscillate in the mind of the user of the interface" (Biocca 1997). My practice opens up and explores these moments of oscillation in which the participant can be in a liminal state, between virtual and physical bodies and environments. In designing the workshops for this research, rather than overriding or suppressing the moments in which the physical body and space momentarily come to the fore of the participant's attention, I wanted to focus in on these moments. To explore the movement, or oscillation, of presence and the conflict between the virtual and the physical as a space of possibility and of movement. This approach is in contrast to VR technologists who uphold "an effort to fully embody the user in the virtual environment" (Biocca 1997) through the "sensory suppression of the immediate environment" (Biocca 1997). With aims to immerse the participant in the VE using "the capacity of those senses engaged by the system" (Biocca 1997) – vision. To saturate the user in visual information, which thus "suppresses stimuli from the physical environment" (Biocca 1997).

Bringing the other senses into play in a VE increases immersion in that environment and suppresses the sensing of the physical environment. Audio and haptic stimuli (and also smell)

have been used to encourage the participant 'further in' to the virtual domain, through engaging with more of their senses "to allow users to not only see and hear, but also to feel, virtual worlds" (Cheng, Marwecki and Baudisch 2017). The development of sound for VR is relatively underdeveloped compared to its visual counterpart. The "correct and wide coupling of sound to visual applications is still missing in most VR environments" (Faria, Zuffo and Zuffo 2005: 1). Understanding the realm of touch-based sensations, or haptics, the term recognised in the field of physiological psychology, "proposed as a more general designation, encompassing [the tactile] sensations that arose from both the skin and [the kinaesthetic, proprioceptive, vestibular senses of] bodily movement" (Parisi 2018: 104-105) has proven difficult and complex. A scientist working for Oculus VR, Michael Abrash argues that "haptics is at the core of the way in which we interact with our surroundings, and without it, we'll never be fully embodied in a virtual world" (Parisi 2018: 3). He goes on to say, "[a]s important as haptics potentially is for VR, it's embryonic right now. There's simply no existing technology or research that has the potential to produce haptic experiences on a par with the real world" (Parisi 2018: 3). Certainly, haptics has not met (in the same way that visual display technologies have) the 'blueprint' laid out by Sutherland in 1965 - in an address to the International Foundation for Information Processing. The kinaesthetic display, as Sutherland envisioned it, "would capture the movements of the human body, and in response, project forces back onto it, effectively simulating the body's physical interactions with matter" (Parisi 2018: 2). Whereas vision and sound can be used to produce immersive effects, "[f]eeding the complex and variegated data of touch back… [has] proved nearly impossible" (Parisi 2018: xv) and "[t]he haptic system [has] resisted translation into machine-legible code" (Parisi 2018: xv).

There have been very recent haptic developments for VR (2020), devices such as *Pivot Tech*, using which the user can receive various physical and tactile feedback to seen stimuli in the VE; and hand tracker software such as *Hand Physics Lab* on *Side Quest* (for Oculus) and *Stereo IR 170* produced by *Ultraleap*, using which it is possible to interact directly with the VE without any wearable or handheld devices. Regardless of their accuracy and the transparency of embodiment-relations (Idhe 1990) in their use, these haptic technologies, which integrate with VR technology, are reliant on the visual information presented in the VE. Without the visual information, the haptic sensations would make no sense. The reliance on the visual for haptic sensations contrasts the use of touch and the felt sensing that happens in dance. For example, the sense of touch is prioritised in many (partner and improvised)

dance forms, such as Contact Improvisation, as a mode of communication between bodies; and it is used extensively in somatic-dance practices for guidance and support. This 'dance touch' does not rely on vision to sense-make, as haptic sensations within a VE do. In these dance practices, touch occurs with vision playing a supporting, not a dominant, role. When a participant is within a VE, they can sometimes experience touch to their physical body, to another body or to the physical world, unseen to them in the VE, and this creates a confusing sensation – a perception gap. Haptic devices, such as the ones I have described, map directly to the visual VE and enhance the experience of that environment, but these sensations are wholly reliant on the visual. Closing the eyes within the VE would render a haptic experience nonsensical.

Drawing from philosopher George Berkeley, architect and scholar Juhani Pallasmaa writes that the "visual apprehension of materiality, distance and spatial depth would not be possible at all without the cooperation of the haptic memory" (Pallasmaa 2012). When a participant is in a VE, there are moments in which the visuality of the environment can bring about haptic sensations (the sense of touch to a virtual entity or environment with no physical counterpart and using no haptic device). This is a phenomenon called pseudo-haptics, a field of study described by Anatole Lécuyer, researcher of multimodal perception. "Pseudo-haptic feedback corresponds to the perception of a haptic property that differs from the physical environment, by combining visual and haptic information and proposing a new coherent representation of the environment" (Lécuyer 2009: 39). Pseudo-haptic perception "is different from what the real haptic sensory supply would suggest by 'playing' with the multimodal – mainly the visual – feedback of a system" (Pusch and Lecuyer 2011: 1). The sensation is achieved through "visually presented phenomenon" (Pusch and Lecuyer 2011: 2) which "should theoretically be capable of returning some kind of force" (Pusch and Lecuyer 2011: 2), and matching this sensation of force to a defined action or movement. This results in the sensation of 'feeling' that object or force is a physical presence, "the user's central nervous system may adapt to the new, the artificial multisensory supply – and the illusion occurs" (Pusch 2008: 14). In the moments of a perception gap, in which the "brain is confronted with ambiguous multisensory data" (Pusch and Lecuyer 2011: 3), the visual information takes precedence, "it attempts to resolve it by recalling related information from memory in order for the final percept to settle" (Pusch 2008: 3) and this is typically dominated by vision.

The intricate connections between touch and vision and between all of the senses are woven together in sensation. The pseudo-haptic sensations derived from the visual information of the VE are drawn from the accumulation of sensory learning and the forming of habituated links across the senses. Pallasmaa writes about these linkages, specifically between touch and vision. Rather than vision dominating the senses across these connecting pathways, the notion that vision merely "reveals what touch already knows" (Pallasmaa 2012: 46), he writes that, instead, "vision needs the help of touch" (Pallasmaa 2012: 45) as "sight detached from touch could not have any idea of distance, outness of profundity, nor consequently of space or body" (Pallasmaa 2012: 45). In the VE, the body is drawing from this sensory linkage and haptic memory to draw out the tactility, the felt experience, of the visual virtual world and the entities within it. The ways in which dancers, who work with somatic and improvisation practices and with the senses synaesthetically, operate around these notions of touch and vision, and how these dancerly modes of sensing connect and collide with the ways in which sight and touch is developed for and used in VR technology, will next be discussed.

Tuning Practices toward a Tactile Sensibility in Dance

I developed the workshops for this research through the processes of combining my dance practice with VR technology, to open up possibilities for experiencing the perception gap. Dancers and technologists understand and practice the senses differently and, in this next section, I discuss specific ways in which the senses are considered and organised in dance practices.

Dancers, working somatically, access their bodies and establish dynamic relations with other bodies and the surrounding environment in improvised practices of moving and sensing. This often begins through tuning into the body as an attentional process, to follow and move with the felt sensations of the body. In these somatic practices, sensations of the body and of the surrounding environment shift from being separate and fixed into a state of flow. The body becomes porous, malleable, extended within and beyond itself through an attention that is infused with tactility. Honing this "tactile attention" (Little and Dumit 2020: 276) as a practice, and which can be developed as a sensory skill, is investigated by dance scholar and practitioner Nita Little. In her teaching sessions, Little invites her dancers to explore both a 'skin touch' and a 'space touch', notions embedded in the sense of touch as not just a surface-

to-surface, skin-to-skin contact and connection, but as that which expands through the air and between bodies.

> When I reach out to touch you, I extend the space I have created between me and you. This extension carries my sense perception (my almost-touch) and can therefore also be considered as prosthetic to my 'organic' matter-form. (Manning 2007: xxiii)

The dancing body extends beyond its skin boundaries to meet the 'other' in the spaces between bodies, between surfaces, sensed through a tactile attention. Little writes, "[w]ith space between them, individuals may extend a field of awareness that weaves them into tactile configuration, a volatile form of togetherness" (Little 2016: 1), noting that this "dynamic weaving of our tactile presence" forms "an important relational aspect of a dancer's presence" (Little 2016: 1). Dance improvisation practices or "training structures" (Buckwater 2010: 95) – such as Nina Martin's *Ensemble Thinking* and Lisa Nelson's *Tuning Scores* – support dancers to "learn something of the nature of seeing" (Buckwater 2010: 124) as more than a visual process, through ensemble and relational tuning practices. Nelson developed her tuning work to explore "movement as a response to environmental influences – both the external and the internal" (Buckwater 2010: 122) and the "co-dependence between the senses and the moving body" (Buckwater 2010: 122), shifting the patterning of the senses "from a visual to a kinaesthetic perception" (Buckwater 2010: 123). Applying micro-phenomenology to the improvised dance of the Argentine tango, Michael Kimmel writes about the dissolving of individuality and transcendence toward a "bodily intersubjectivity" between dancing partners (Kimmel 2013: 77). This relational quality which enables a sort of bodily communication, is occurring within somatic and improvisation-based dance practices. These practices cultivate felt-based relations between bodies in motion through physical touch and expanding the sense of touch beyond the body. These modes of sensing and communication between dancers reduce reliance on the visual information of the bodies and the environments in which they move; visualities that are embedded with complex and layered notions of identity and place and social-cultural behaviours. Dancers move in response to the felt materiality of the body, to sensations of weight, depth, flow, tension, force, etc., that occur both within the body and within the spaces and bodies that they move with. In attending to this felt sensing, the dominant role of vision opens to include the other senses. "There is an uncovering of a physical dimension of seeing" (Buckwater 2010: 94), and the eyes can "function like organs of touch" (Marks 2000: 162). These practices support

a more flexible linkage within the senses, "restoring a flow between the haptic and the optical that our culture is currently lacking" (Marks 2002: xiii). In this research, these practices are brought to technologies which revolve around a visual engagement and do not function to serve these interoceptive, felt or tactile synaesthetic modes of sensing.

Dancers often work with their eyes closed, with a blindfold on or in spaces of (interior and exterior) darkness, to locate and sense the body in the absence and dominance of visual information. This enables them to access the interior environment of the body and also its relationality to and within the surrounding environment as a dynamic, responsive and felt phenomenal experience. This method of depriving vision is employed to tune in to and tune up a non-visually dominant perception, and to re-focus sensory attention toward somatic, felt, interoceptive sensations, which can be accessed more readily even once sight is resumed. This sensory training can take time, and a practitioner might work repetitively with this practice to bring about a more flexible sensory attention, and therefore agency. Touch becomes more than a direct physical contact between bodies and surfaces, sensed as a broad palate of tactile relations reciprocally between human and non-human bodies and their environments. When the eyes are opened again, or the blindfold is taken off, and visual information is brought back into sensing, seeing becomes synaesthetically mixed with, not dominating, the other senses. Seeing is enhanced with tactility and touching becomes a way of seeing the world. These practices lead to the experience, conveyed in Ingold's words, of "a perception that inheres in the environment of materials and awareness rather than in the projection of objects as images" (Ingold 2013b: 121).

> What we have is the senses and the really ordinary stuff – breath, the heartbeat and pulse. In the standing, we have the reflexes as easily observable events that the consciousness is not causing and can take a moment to wonder at. The standing is happening all over the body, so you get a full-body event that you are watching, and one that you are not seeking; it is just happening. You have a thing to focus the mind on. (Paxton 2015: 39)

Dance-somatic and improvisation practice *The Small Dance* (1977), developed by Steve Paxton, one of the founders of Contact Improvisation, invites the practitioner to attend to these bodily micro-movements. The continuous sensory flow of proprioception is "from the movable parts of our body (muscles, tendons, joints), by which their position and tone and

motion are continually monitored and adjusted" (Sacks 1985: 26). This "automatic and unconscious" (Sacks 1985: 26) process is usually "hidden from us" (Sacks 1985: 26) and is brought to attention through this practice. Closing the eyes in *The Small Dance* supports an attentional shift away from visual information about the body and the world around and encourages the practitioner to draw on their somatic (interoceptive) senses (proprioception, kinaesthetic and vestibular senses, as well as the sense of touch) which govern bodily position, movement, balance and touch. Sensations, such as the weight of the head and the subtle extension and contraction of the spine and limbs come into attention, as well as the body's relationality with the external world – in the body's constant dance with gravity and in the mixing of air with breath. David Abram, drawing on Merleau-Ponty, writes about this "reciprocity, the ongoing interchange between my body and the entities that surround it" (Abram 1997: 52) as "a continuous dialogue that unfolds far below my verbal awareness" (Abram 1997: 52). "[T]his silent or wordless dance always already going on – this improvised duet between my animal body and the fluid, breathing landscape that it inhabits" (Abram 1997: 53) is entered into in dance practices such as *The Small Dance* and many others.

Moving in the darkness of the woodlands in West Wales (one of the places in the UK that it still gets reasonably dark, with little light pollution), as part of the *Practicing Places* workshops with dance artists Simon Whitehead and Kirstie Simson (2016-2019), enabled me to explore the sensory phenomenon of moving and witnessing movement in the dark. Experiencing my dancing body and that of another synaesthetically, aspects of that which I had previously explored with my eyes closed or with a blindfold on, but instead with my eyes wide open into the surrounding landscape. I experienced my workshop partner moving in front of me, as profoundly visual, despite not 'seeing' her. The sound of her movement and of the surrounding environment moved through my body as a physical and tactile sensation. My sense of space extended beyond what I knew to be the boundaries of the densely wooded area we were in, and our bodies morphed in shape and size, together as one in some moments and expanded into the far distance in others. In the darkness, expanded possibilities for moving together with an environment, with other bodies – moving *as* the environment and *as* the 'other' occur. Relations of human and non-human become continual processes, materialising "in their ongoing iteratively intra-active reconfiguring" (Barad 2012: 77). Nina J. Morris, who writes about the phenomenon of night walking, considers the ways in which darkness "forces one to question how one's body is in relation to that which surrounds, challenging

one's human sense of bodily presence and boundary" (Morris 2011: 315). Having my eyes open to the world, in darkness, felt completely different to closing the eyes or to wearing a blindfold due to the physicality of having the eyes open and being able to move with the eyes involved in that movement. This brings both an enhanced state of alertness, a waking up of bodily senses deactivated when the eyes are closed, and also a feeling of vulnerability – of not being able to see (a feeling which also occurs with the eyes closed or with a blindfold on). After some time in the darkness of the woods, my eyes start to adapt to night vision mode, and subtle nuances of shading, tonality and texture in the dark landscape emerge.

> Human sensory orders are recalibrated when faced with the reduced illumination levels of the night; it is harder to judge depth and distance, details are obscured, colours muted, and one is obliged to compensate for this loss of visual acuity by drawing on the other senses. (Morris 2011: 315).

The VR headset or HMD acts as a kind of blindfold, closing out all of the visual information of the physical body and environment yet with, as I experienced in the dark environment of the woods in Wales, the eyes wide open. The difference between the dark landscape and the VE is the visual stream of information, the replacement 'world' seen through the HMD. In the somatic-dance practices of expanded seeing within darkness that I have discussed, the visual information that occurs arises through the imagination – through processes of visual imagining in congruence with the other senses taking in the body within the dark environment. In the VE, the physical body and environment are not visible, and they are also backgrounded in the experience, as the replacement visual VE becomes the dominant reality and perceived environment. The non-visual information read by the body with regard to its interiority and surrounding environs is still available but, as the brain/cognitive system rallies to align with the dominant visual VE, this sensory domain is reduced in its capacity to draw attention or altogether lost.

Both VR and dance practices expand normative modes of sensing: seeing in VR brings felt or touch-based sensations based on the visual information and the movement of that information (as pseudo-haptic experiences), and dancers tune into a mode of seeing which de-centres visual processing to support a synaesthetic mixing which infuses seeing with the non-visual sensory information. The research workshops I write about in the next section bring these VR and dance practices together, emphasising their different approaches to vision and touch,

their practices of seeing and feeling. Combining VR and dance in this way opens up the perception gap – a phenomenon that forms the basis for the development, design and facilitation of the workshops.

Part Three: Critical Themes from the Workshops

The final part of this chapter highlights and discusses some of the critical themes that have arisen from the two sets of workshops, offering areas of learning which I have taken into the next phase of practice – the development of participatory performances.

In the first section of this thematic discussion, I critically examine the central theme that emerged from my analysis of the workshop material; and following on from this, I detail and interrogate further sub-themes from the workshops. The main theme, which builds on the questioning that I took away from the Arnolfini dancer's labs, concerns the ways in which the *WOS* participants dealt with their bodies as unseen in the VE and how this correlated with their perceptual processes when working with eyes closed or with a blindfold on in somatic-dance work. The following sections explore: the theme of connection – through the visuality of their presence in the VE, the tactile sensing of the VE as a pseudo-haptic sensation and using sound; the after-space of the VE, as the final task in *TFS* workshops, specifically addressing the impact of the VE on the imaginations of the participants in *TFS*; the notion of somatic agency in combining somatic practice and VR technology, drawing directly on the workshop participant experiences; and lastly, in concluding this chapter there is a brief discussion on the ways in which the participants across both sets of workshops each came with different expectations, needs and desires, and that understanding and responding to 'difference' is a key element in considering the development of performance work with VR that is participatory and inclusive. The ideas and practices from the workshops lay the ground for the next phase of practice, the design and crafting of the participatory performances *Figuring* (2018) and *Soma* (2019), discussed in Chapter Three.

The Nuances of Perceptual Processes: Unseen Bodies in the VE

Building on the learning from the experiences of the dancers in the labs at Arnolfini, the *WOS* workshops were designed to help me further unpack the ways in which the dancer-somatic participants in the workshops accessed, tuned into and moved their body when it was unseen

in the VE. As somatic-dance practitioners, operating and moving within a blindfold was common practice for the *WOS* participants, and they were very comfortable with moving and exploring the physical environment and accessing their bodies in the darkness (of a blindfold and with the lights off). Removing their blindfolds from behind the HMDs and entering into the visuality of the VE exposed differences in the ways in which the participants were able to tune into and move their bodies as 'unseen' in the visual VE. The somatic-dance route into VR, i.e., moving into the VE from darkness/a blindfold, exposed different sensory processes across the participant group. There were two different and contrasting responses drawn from the workshop discussions, which revealed these differences. Some participants were able to sense and move their bodies as unseen in the VE, drawing on their somatic sensibilities to access their bodies and, in doing so, felt a sense of freedom similar to that which they gained from moving with the eyes closed or with a blindfold on in their practice. For other participants, this process was much more difficult, requiring them to access their visual imaginations. However, the visual stream of sensory information received by their bodies was already being 'used' by the VE. These participants subsequently felt disorientated and unsupported, experiencing a sense of weightlessness and having a physical desire to find the ground, or to connect with someone. They were "seeking other beings, location, something, to ground me" (Participant 2017b: 13) as "making contact was reassuring" (Participant 2017b: 8). This second group of participants found the experience of the VE and of their 'missing body' "unsettling" (Participant 2017b: 4), giving them a "sense of vulnerability" (Participant 2017b: 14).

A specific discussion between two of the participants in the second *WOS* workshop highlights these different responses to the VE, and which had exposed the different sensory processes within their practices.

> Participant One: I could powerfully feel the whole body, [be]cause I knew there was a whole body there and maybe because of the training we have, in somatic, I can feel where you were, pretty much. (Participant 2017b: 8)
>
> Participant Two: I think what I found so disconcerting was that I couldn't see my own hands ... I couldn't find any space to be because I kept seeking the wall and the wall wasn't there... it was just too much, and so I just kept trying to seek, find a space and then seeing another person but also not knowing where your body is and not knowing

> where my body is, it's really overwhelming and slightly disconcerting for me. (Participant 2017b: 8)

Once Participant Two was given the handheld VR controllers to hold, she could then see the representation and the location of her hands in the VE, "It was a real relief" (Participant 2017b: 9). She goes on to say, "I really didn't like not being able to see my own limbs, my own hands, I didn't like it when I first went to the ground, and I was, like, 'Oh I can't, why is this so disconcerting?' whereas blindfold I was happier on the ground than standing and it's because I was relying on my visual sense" (Participant 2017b: 9). The first participant was surprised at these comments. She had thought that the visual effect or representation for the limbs or the hands would not be needed if "you are somatically experienced" (Participant 2017b: 10). She was, afterwards, surprised at her "judgement" (Participant 2017b: 10), as she had been convinced that it was her somatic background that had been the "reason why I was so comfortable not knowing where I am" (Participant 2017b: 10). In response, the second participant talked about the experience occurring in the way that it had done for her "because I was relying on my visual sense, and then I couldn't see" (Participant 2017b: 9). She reflected, "I think when my eyes are closed, I have a really strong sense of where my hands are, but it's when they're open, and it's so stimulated visually that the visual sense takes over and then it's almost like my proprioception goes into low volume, my vision is high volume, so then having the things (controllers) then wakens up my kinaesthetic sense more" (Participant 2017b: 10).

There are similarities between being unseen in a VE and being in a dark environment because the eyes remain active (which is distinct from having the eyes closed or in a blindfold). In the dark, the other senses rally to perceive the environment, whilst in the VE, the physical environment in which the participant is physically located is not visually present, and the dominantly perceived environment is simulated. Alston and Welton, theatre and performance scholars who write about *Theatre in the Dark* (2017), remark that "one's visual sense remains active" (Alston and Welton 2017: 18) in "conditions of total blackout" (Alston and Welton 2017: 18) in which "one actually sees 'nothing'" (Alston and Welton 2017: 18). Writing on her experiences of night walking, Morris describes "the strange sensation of not being able to see one's hand before one's face on entering a pitch-black night will affirm that darkness challenges the human sense of bodily presence and boundary" (Morris 2011: 316). Experiencing the body as unseen in the darkness with the eyes open can create a "feeling of

liberation which can be uplifting, but also a sense of surrender which is unsettling" (Morris 2011: 316). Accessing their bodies as unseen with their eyes open to the VE exposed similar contrasting sensations in the *WOS* participants. Their somatically led route into the VE in the workshops had revealed different processes that were at play in the senses of the participants, aspects or nuances of their practices that they had previously be unaware of.

It seems that the second participant habitually accesses and moves her body in somatic practices that take away visual input, with the eyes closed or a blindfold on, through the use of her visual imagination. When the blindfold was pulled out from under the HMD, the visual stream of sensory information was taken up with receiving the VE, and this meant that she was unable to access her body as unseen using her visual imagination, resulting in her feelings of disorientation and discomfort. "We always talk about having different types of imagination, right? Some people think spatially" (Participant 2017b: 10). Katan-Schmid writes about the first rehearsals for her performance with VR technologies, *Playing in VR* (2017), bringing up similar issues of difference.

> [T]he dancer Lisanne Goodhue could not relate the virtual representations and her dance at the same time. Goodhue described her experience in VR as fragmented – she could either draw or dance. She could not bridge the two experiences immediately and intuitively into one comprehensive practice. To the contrary, the dancer Nitsan Margaliot tended to integrate the score immediately into his dance, to be carried away by it and to identify it, as he reported, with his own imagination. (Katan-Schmid 2020: 227-228)

Katan-Schmid writes, "[a]t the outset, moving in VR technology interrupts the dancers' somatic awareness. While dancing, dancers tend to integrate attentiveness to their bodily feelings in order to complete their movements. Staging dancers in VR is a challenge for their artistic perception since the VR setting converts the experience of how dancers normally lead their dance" (Katan-Schmid 2020: 227). The experience, for Katan-Schmid's dancers Goodhue and Margaliot, opened up a conscious gap, "the dancers became aware to the distance between the environments – the virtual and the actual. The division between the environments affected their trust. The awareness to the gap between environments and to the multi-layered information accelerated" (Katan-Schmid 2020: 228); rather than it disjointing

the experience, the technology provided them with the ability to "develop reflective awareness to the processes of leading visions and movements" (Katan-Schmid 2020: 224).

Sita Popat captures her experience as an unseen body in the VE of *White Island* (2014), a VR piece created by artists and creative technologists Ruth Gibson and Bruno Martelli. The piece draws on S. A. Andrée's doomed polar balloon expedition of 1897, in which Andrée's balloon crashed on the ice near Kvitøya (White Island). The three expedition members perished, and their final campsite was only located later in 1930. Consulting textual and photographic documentation left by the original expedition members, Gibson and Martelli built a computer-generated world using height map data and game engine technology in creating *White Island* as an interactive installation. The *White Island* VE is for one person who uses a VR headset within a custom-built interface (comprised of a rope and an electric fan) with surround sound. The headset is tethered high so as to hang down and then can be lifted onto the heads of participants, using a bungee cord for strain relief when the participant is in motion to take away any touch of the cord to the rest of the body and create the illusion of having no restriction in the participant's head motion. A rope is used to move the balloon through the VE, held in tension between two springs and using a proximity sensor to measure up–down motion and an accelerometer to measure left–right motion, both of which are attached to an Arduino. Electric fans are mounted on a metal ring above the participant's head and are attached to the Arduino/Relay set-up (see Figure 11).

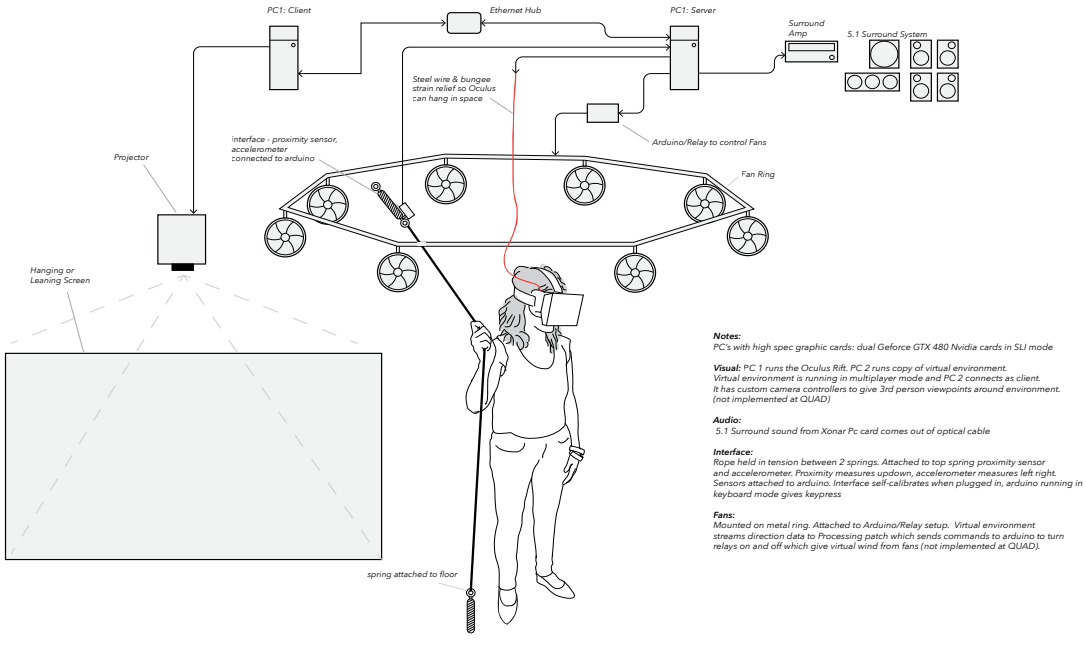


Figure 11: Set-up for White Island Gibson and Martelli (2014)

Popat's description of entering into the VR experience is as follows:

> In July 2014, at the Coleman Project Space in East London, Martelli showed us into a small, dark room, the walls hung with heavy black cloth. A thick, rough rope was stretched vertically floor-to-ceiling, attached at the base to a stage weight and at the top to a metal rig. Next to the rope was an Oculus Rift headset dangling by a wire from the overhead rig. He told us that we could tug down on the rope to gain height and pull up to lose height. (Popat 2016: 361)

Popat's navigation of the VE using the rope drew her attention to the physicality of the experience. Her body was not seen in the VE but felt through her movement and the touch to the rope. She refers to her body as both absent and present, located across two environments. Instead of there being a duality in her experience of her body as physically felt, but 'missing' in the visual VE, her experience was of herself, her body, as "a single subject with blurring boundaries and definitions" (Popat 2016: 371). She describes the notion of a physical–virtual binary as being "indistinct in the blurred body" (Popat 2016: 371) she experienced. The rope was key in this movement between physical and virtual realms, providing a bridge and locating her across both. Her body was unseen in a VE she needed to physically navigate through, and this required her to tap into her proprioceptive and kinaesthetic sensations of balance, movement, and touch – modes of sensing which resonate through somatic-dance practices and training. Her body as absent or 'missing' in the visual VE highlighted its felt presence and supported non-visual somatic and sensory processes through which she could locate her body. In the *WOS* workshops, dance-based practices were set up through which the participants could locate their bodies and the physical environment whilst they were within and experiencing the VE, and which brought up, in their experiences, this physical–virtual layering. Through her layered experience, Popat reflected on her perception as becoming slippery, neither a here nor a there, "*White Island* was neither bodily nor metabodily anchored" (Popat 2016: 371). In the *WOS* workshops, the participants experienced the layering of the physical and digital, their connections to one another across these layers, and an articulation of the senses, through dance-based practices.

Phenomenologist Drew Leder writes about the paradoxical nature of the experience of the body as both absent and present, "[w]hile in one sense, the body is the most abiding and inescapable presence in our lives, it is also essentially characterised by absence" (Leder 1990:

1). He writes that "one's own body is rarely the thematic object of experience" (Leder 1990: 1), although in my research, and also in Popat's experience of *White Island*, somatically-led, the body is placed centrally. Whilst exposing differences in habituated perceptual processes, the *WOS* participants and Popat were consistent in their drawing of emphasis to their bodies in their visual absence in the VE: their bodies were sensed as part of the experience, rather than passively lost or left behind. There are other participants in VR who may have a preference or desire to follow the dominance of their visual perception and to embrace the illusion of the simulated reality, albeit temporary, content to leave their physical world behind. They may seek to lose their body, to use the technology to escape into a bodiless-free zone. This idea was popular in the cyberculture of the first wave of VR (in the 1960s and 1970s). The body of the gamer, "an immaterial and disembodied vision that explores a virtual landscape with relative freedom" (Lahti 2003: 168). Bringing the moving, sensing, relational body into play in the experience of a VE can cause disruption to the flow of the perceived environment or reality through the physical–virtual discrepancies that occur – *perceptual gaps*. With the body absent to attention, the perception gap is less likely to occur. Popat poses what could appear as a rather dystopian possible future in this respect, asking whether "[b]y the middle of the present century, will we be uploading our consciousness into cyberspace and leaving our obsolete bodies, or "meat,' behind us?" (Popat 2017: 360). This idea connects to Robert Switzer's argument, that VR technology "furthers both the project of Cartesian metaphysics – the domination of nature and of our own bodies" (Switzer 1997: 507) in the process of "overwriting" (Switzer 1997: 507) the "physical bodies that constitute our world, and our own involved and empowered bodies" as "code" (Switzer 1997: 507). If VR participants are not attuned to sensing their bodies somatically, nor can they see them in the VE, then where is the body? As Marti Lahti remarks, while the body may be de-emphasized or backgrounded in the use of VR, it is impossible to completely leave behind - "if something is left behind when we play, it is not the body" (Lahti 2003: 169).

One of many applications for VR which relies on the participants forgetting their own body and its physicality and interoceptive sensations is pain relief. To be successful, using VR for pain relief requires the participant to forget the physical sensations of pain present in the body and allow the visual sensation of the VE to take over. Using *Snow World* as an example, a VR application used for pain relief developed by Hunter Hoffman and David Patterson, Jo Merchant suggests that the visual imagery of the VE "is a particularly potent form of distraction" (Marchant 2007: 118) when it comes to pain relief. Marchant argues that using

Snow World VR "consistently cuts pain scores" (Marchant 2007: 120), and "researchers see the effects not just in subjective pain scores but also in brain scans too, with activity in pain-related brain areas almost completely extinguished" (Marchant 2007: 120). In *Snow World*, and other VR experiences designed to immerse the participant in the simulated environment and suppress the physical world (and body), the technology dominates the bodily experience, overwriting bodily sensations of pain and changing neural activity. However, whilst *Snow World* is very good at relieving pain for short periods of time, "the effects disappear as soon as they take off the goggles" (Marchant 2007: 124) – the pain relief is reliant on the technology. What can be drawn from this is the relationship between attentional focus and bodily experience and the mediation of technology to draw attention (through the senses, i.e., the dominant visual sense). "It's all about attention, says anaesthesiologist Sam Sharar, who runs the [experiential pain] lab [at the University of Washington]. The brain has a fixed capacity for conscious attention. We can't increase or decrease it … but we can chose what we pay attention to" (Marchant 2007: 118). My research is an attentional investigation into body-technology relations using VR, tooling participants by using somatic-dance practices to open up their sensory awareness to the ways in which the technology mediates their attention and also providing options for shifting the attentional experience which is driven by the technology to one which is driven by tuning into the body. This attentional practice with VR can offer increased flexibility in the senses and sensory agency in human encounters with technology. This attentional training might be potentially useful to support the ongoing effects of pain relief using VR through recalling a specific attentional mode. I will now move on from this detailed discussion concerning the multiple facets of this key workshop finding of the sensory processes intertwined with having an unseen body in the VE to discuss a number of other emergent themes from the workshops.

Expanded Sensing – Visual, Tangible and Sounded Connections in the VE

Moving Visualities

The VE as a shared environment was a key aspect of the experience for both *WOS* and *TFS* participants, in particular when there was a visual representation of the body in the VE through which the participants could acknowledge and communicate with one another visually. *TFS* participants felt less self-conscious undertaking the tasks in the VE compared to the physical space. Being in the VE took away the social awkwardness of the physical

environment and the complexities of seeing and being seen in the earlier tasks, “I didn’t feel self-conscious [in the VR]. Once you had the headset on, you didn’t care about that because you’re in a different world” (Participant 2018d: 3). The *TFS* participants also felt that having the visual bodily representation in the VE was a levelling experience, “[i]t was my first time being in VR with other people and I actually really liked it, because everyone feels really equal because you look the same and I kind of prefer that to real life” (Participant 2018d: 6).

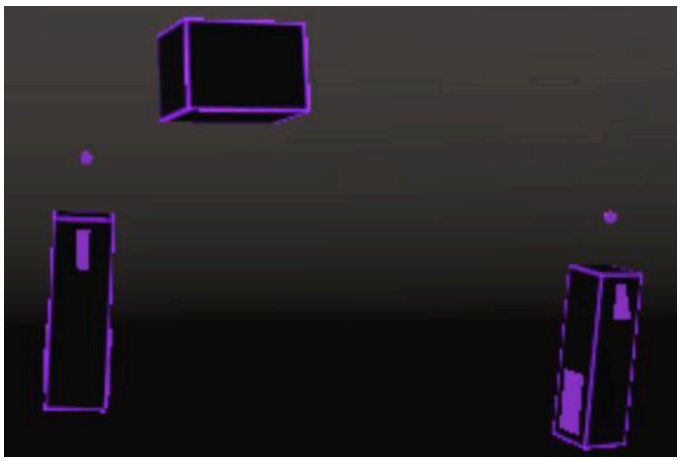


Figure 12: HMD and controllers in the VE, how the participants saw one another in the VE in WOS workshops

Most of the *WOS* participants had not experienced VR technology before and had little or no preconceived ideas or expectations about the experience. On entering the VE, they were unaware of what they would find there, including each other. Whilst their own body was visually absent at the start of their VE explorations (before they were handed the controllers), they were able to see each other through visual representations of the VR headsets, rendered as simple rectangles (see Figure 12). The movement of the rectangles in the VE corresponded to the head motion of the participants wearing them. Using embedded sensors in the headsets, the position and orientation of the participants were tracked by lighthouse cameras positioned in the space. The ability to see each other’s heads as rectangles meant that participants could imagine their own heads similarly and connect the motion of other rectangles to that of their own, which encouraged them to move more. Finding each other in the VE was a transformative, “exhilarating” (Participant 2017b: 8) moment; “you no longer really feel alone” (Participant 2017b: 3). It shifted the experience from one which was initially solitary to one which was shared, “as soon as I saw that these other floaty heads I was like, ‘ahh, that’s me’ like I have friends in this world that I am here with” (Participant 2017b: 3).

The bodily representations of participants in the VE were formed based on the positioning and location of the technology – the VR headsets and the controllers – rather than the actual bodies of the participants. The reduction of the body to these three points still enabled the participants to have a sense of presence and embodiment, of 'being there' in the VE, and a recognition and communication with other bodies inhabiting the VE with them. Slater, Hansen and others point out that a participant's sense of presence in a VE is supported through being visually located as a virtual body or avatar representation in that VE. The 'body ownership' of a virtual body or avatar requires an accord, an agreement for transfer – of presence, of location, of form, etc. – between physical and virtual bodies. This sense of body ownership (Slater 2012) can lead to a sense of presence and embodied agency within a VE. However, it is not simply the visuality of the avatar or virtual body that is key to the sense of presence; it is its located-ness and movement, "the reality of experience is defined relative to functionality, rather than to appearances" (Sanchez-Vives and Slater 2005: 333). Along these lines, Kozel points out that the virtual space is a "verb-space" (Kozel 2007), a site for action and movement and the key to "the sense of being there in a VE is grounded on the ability to do there" (Sanchez-Vives and Slater 2005: 333). If the relationship between the moving, physical body and the avatar does not tally, then there is a loss of belief in that virtual body and a subsequent loss of presence as part of and with agency to act in that 'world'. "[I]n order to perceive we use our bodies" (Slater and Sanchez-Vives 2016: 4-5), and it is "[t]he real-time update of sensory perception as a result of movement" (Slater and Sanchez-Vives 2016: 5). It is this movement, for example, as "we turn our head, move our eyes, bend down, look under, look over, look around, reach out, touch, push, pull …" (Slater and Sanchez-Vives 2016: 5), that "gives rise to the sense of 'being there' – the illusory sensation of being in the computer-generated environment" (Slater and Sanchez-Vives 2016: 5).

The interaction between the *WOS* participants occurred through the movement of their coloured rectangles, as heads and hands. They communicated through head motions such as tilting and nodding actions, acknowledging one another's presence in the VE and waving to each other with their controllers to 'say hello' (see *WOS* video document at timecode 3:36-3:39 and *TFS* video-document at timecode: 4:21-4:24). These simple gestures supported the participant's sense of presence in the VE and their agency to communicate with one another within the VE.

> The last part, when we had the VR headset on and I was given the instruction or the opportunity to say hello to the other people, I don't know who the other, I think mine was green or yellow, now I forget the colour, but somebody else was there. We were just doing tilt left, tilt right and that was the most exhilarating thing I've ever had in my life. It was like a rectangle tilting sideways. (Participant 2017b: 8)

Slater writes, "the virtual body is a body representation slaved to the available tracking devices" (Slater and Usoh 1994: 4), centred around the position of the technology rather than the movement of the body, "the rest of the body's sensorium and motorium has been neglected or considered peripheral to the immediate aims of VR" (Murray and Sixsmith 1999). In processes of reducing the body to a few 'points of light' (such as was done in experiments undertaken by Gunnar Johansson (1971) and James Cutting (1978)), so long as the movement of "the lights are matched to the movement of the body" (Cutting 2012: 13), there is the ability to recognise that there is a body, and of the specific movements undertaken by that body. "[I]ndividuals could identify themselves and friends from the motion patterns of a few points of light, and, in retrospect, I think this was our most important result – one of social perception" (Cutting 2012: 13). Using very minimal information as bodily markers, as was done in the workshops with the rectangles connected to the head and controller 'trackers', an increased sense of presence in the VE, and the ability to recognise others and to communicate with them through movement (using these markers) can occur. This way of working with the visuality of the body in the VE was further explored in the VEs for *Figuring* and *Soma* (discussed in Chapter Three).

Spatial and Bodily Densities

In a VE created by VR technologies, there can occur a tangible sensation of the presence of the environment and of the virtual objects within that environment, despite there being nothing physically there – a pseudo-haptic sensation drawn from the visuality of the environment. I have felt the movement qualities in my own body and observed those in other bodies moving in a VE with the sensation of a resistance, or 'drag'. For me, this movement quality becomes more pronounced when my body enters into the space of a virtual entity or form, or when that virtual entity or form enters into the space of my body. When my body and a virtual 'other' assume the same area of (virtual) space, there is a sort of merging that takes place – of my body and this virtual form or entity – and a change in the quality of the

'substance' of that area of space. I experienced this sensation during an AR prototype (*The Grinning Man* at Bristol Old Vic, 2019). Moving toward and into the virtual body space of one of the virtual actors, I felt this sensation of resistance and merging, as if my substance and that of the virtual actor had created a thicker or denser area of space, felt as a physical, tactile sensation. The transcending of the 'borders' of my body and the body of the actor is something that is not possible in the physical world, and this 'passing through' requires a shift in thinking on the body/as a body – from a distinct and bordered 'self' to a border-less, combined body – a post-human body. Watching others and observing myself move within a VE using VR technologies, I have experienced a contrasting experience to this passing through – 'flinch reactions', instinctive movements away from a virtual form or entity approaching or moving in toward the area of the body. *TFS* participants experienced this reaction on the approach of the virtual ball towards their bodies, "[I had to] move away from it, duck" (Participant 2018c) (see *TFS* video document at timecode 5:06-5:07). Though, participants also experienced the sensations of "merging and melting" (Participant 2018c) with the virtual balls, similar to my experiences of passing through the virtual actor's avatar. The VE and the entities of that environment offer a tangible presence to the body, and the body responds - "[in VR] my body naturally reacted to the virtual ball's actions when it came too close or was falling to the ground. I felt the body responding to the virtual ball like an instinct" (Participant 2018a).

The *WOS* participants commented on the 'air' in the VE feeling "thicker" (Participant 2017b: 7) than the air in the physical world. This synaesthetic sensation caused a kinaesthetic response, an inward movement and contraction, "It must do something to the kinesphere, that [it] kind of shrinks in response to that virtual world" (Participant 2017b: 7). Exploring the visceral response to the VE is something that artist Char Davies seeks to establish in her installation work using immersive technology. She writes about the potential of the medium of an immersive virtual space as "a physical space in the sense of being extended, three-dimensional and enveloping" (Davies 1998: 69). Her "extreme myopic (near-sighted) vision" (Davies 1998: 66) caused her "to abandon the photo-realist world of hard edges and solid surfaces" (Davies 1998: 66) and to create immersive experiences which "dissolve boundaries between interior and exterior" (Davies 1998: 66).

The body draws on its haptic memory, ascertained in the physical world, and applies this information to the visuality of the VE, which can result in pseudo-haptic sensations. Without

the visual information, these visceral sensations of touch and tactility would disappear, though they may perhaps leave some form of memory or *residue* behind in the body (a phenomenon discussed later in this chapter). In dance practices, moving with the eyes closed in the physical environment, with no visual information, reveals different facets of that environment, activating senses which are often suppressed and increasing a felt-based sensing and relationship between the human and non-human worlds. The *WOS* and *TFS* workshops offered somatic-dance routes into sensing and feeling, inviting the participants to explore practices that re-tuned their senses, albeit temporarily, away from the visual world and toward a felt sensing of their body, other bodies and the environment. They explored these modes of sensing whilst in an engagement with VR, a technology that demands the visuality of its environment as the driver of sensation. Pallasmaa considers the reduction and restriction of the sensory system to a visual process as unhelpful to human and social well-being, "the isolation of the eye outside its natural interaction with other sense modalities" (Pallasmaa 2012: 43) causes an "elimination and suppression of other senses" (Pallasmaa 2012: 43), which has the potential to create "a sense of detachment and alienation" (Pallasmaa 2012: 43). With extensive use of technologies such as VR, it is possible that the human sensory system would adapt toward a visual servitude, and the nuanced sensibilities of touch and the capacity to sense without vision, or with reduced vision, would diminish through this haptic dependence on vision. Both the visuality of the VE and the missing visual information from the physical environment, the non-visual senses, were called into action causing the workshop participants to experience physical and tactile sensations within their bodies.

Sounded Interactions

In the *WOS* workshops, sound was used to create a calm atmosphere for the workshops and was also used as an audible timer, reminding participants at the start and end of each task. The sound was modified in response to participant activity (by UoB PhD student Alex Jones), though it was not interactive. In *TFS* workshops, the sound was developed as a more intrinsic element of the workshop activity, as a mode of interaction with the virtual balls in the VE (task five). *TFS* participants interacted with the virtual balls using their VR controllers and, as they moved the balls, the sound was created. The virtual balls (as molecular virtual entities 'Buckyballs') were sonified in the VE according to the amount of kinetic energy produced by the interactions (achieved by researchers and academics in sound technology Alex Jones,

Tom Mitchell and Jo Hyde). In this task, there was no visual information provided, and the participants were invited to connect their movement with the sound that they were hearing to sense the presence of the virtual balls within the VE. Whilst some of the participants managed to sense the presence of the virtual balls through movement collaboration in response to the sounds (see TFS video-document at timecode 3:46-3:52), others found the connection tricker. The relationship between the movement of their controllers and the sound feedback "didn't match coherently" (Participant 2018c). Participants commented, "I couldn't get my head around the link between the movement, the ball and the sound" (Participant 2018d: 1), "for me, it [the sound] didn't have a correlation with the movement" (Participant 2018d: 5) and therefore, "[I had] no sensation of a ball moving" (mark-making data). When there was more than one participant connected to and moving the virtual string, the participants found it difficult to ascertain who was creating which sounds. Even once the participants were visually in the VE, within the VR headsets, with the sound (task 7), the participants still struggled to find the connection between their movement, the visuality and the sound of the virtual balls, wanting "the sound to be more reactive" (Participant 2018d: 4), for example, "when I bring the ball up, I kind of want the sound to go up" (Participant 2018d: 4).

Researcher Chia-Jung Tsay, who examines the psychological processes that influence decision-making and interpersonal perception, writes about and evidences the dominance of 'sight over sound' in the senses. She argues that this dominance occurs "even when sound is consciously valued as the core domain content" (Tsay 2013: 14580) and that this highlights "our natural, automatic, and nonconscious dependence on visual cues" (Tsay 2013: 14580). Her notion that "we must be more mindful of our inclination to depend on visual information at the expense of the content that we actually value as more relevant to our decisions" (Tsay 2013: 14583) is relevant to the questioning of my research. Specifically, how the reliance on visual information in the senses translates once situated within a VE, as this reliance results in the suppression of the other sense-modes. The sound-specific interaction task in *TFS* workshop oriented around the participants mapping their movement with the sound they heard. In bringing the sound in, I was interested in the ways in which the participants might create for themselves a 'mental model' of the virtual entities of the VE (in their imagination), from which they might experience a tactile, or felt, sensing of that model with no visual input. The experiences of the participants and the challenges they encountered in doing this task brought up questions about how sound is factored into a VR experience, either as an

accomplice to the visual or as a sensory means by a different perceptual gap opens (i.e., between the seen and the sounded). The issue of sound problematises the questioning of this research, increasing the complexity of the perception gap between seeing and feeling. Whilst sound was developed further for *Figuring* and *Soma*, the depth of investigation into using sound as part of a wider exploration of the senses, and the synaesthetic mixing within the senses, was beyond the bounds of this research and for which I have made recommendations for further study.

The *Residue*

One of the key takeaways from *TFS* workshops was the radical shift the participants made between the first imagination task (task two) and the second imagination task (task six). Reflecting of the first imagination task, participants commented, "I've not got a very good imagination" (Participant 2018d: 3), and "I struggle to imagine things" (Participant 2018d: 4). In this first imaginative task, they tended to imagined familiar and recognizable balls, "a tennis ball" (Participant 2018d: 4) and "my son's red ball" (Participant 2018d: 7), commenting, "I don't have the kind of imagination to create something new" (Participant 2018d: 5). One participant remarked on this practice of imagining as one which "goes against most ways of thinking" (mark-making data). In the second imagination task, which took place once the participants had experienced the VE through both sound and vision (tasks four and five), the bounds of the participant's imaginations shifted, "I was imagining a much more interesting ball, rather than a boring ball" (Participant 2018d: 1). The participants imagined balls that did not or could not exist in the physical world, "my concept of a ball was changed" (Participant 2018d: 5). This sense of expansion in their imaginations was a significant finding from *TFS* workshops, "I had more imagination by the end of it" (Participant 2018d: 1). The participants had shifted the worlds of their imaginations from the realms and conventions of the 'possible' to that of the 'potential' between the start of the workshop and this final task. Chvasta offers philosopher Pierre Lévy's reading of Deleuze on the relationship between the possible and the real:

> The possible is already fully constituted but exists in a state of limbo. It can be realized without any change occurring either in its determination or nature. It is a phantom reality, something latent. The possible is exactly like the real, the only thing missing being existence. The realization of a possible is not an act of creation in the

> fullest sense of the word, for creation implies the innovative production of an idea or form. (Chvasta 2005: 165-166)

Chvasta writes, "we have a tendency to concretize the possible" (Chvasta 2005: 166), and this process "[s]trips away at potentiality – the essence perhaps, of life" (Chvasta 2005: 166). In the second imagination task, the participant's imaginations extended to encompass notions and entities which were unknown to them. They explored, in their imaginations, a territory unbound to physical convention as "an embrace of alterity" (Chvasta 2005: 166) rather than a "reification, a reduction to the thing" (Chvasta 2005: 167). Erin Manning writes about the potentiality between bodies, present in "every act of reaching toward" and which "enables the creation of worlds" (Manning 2007: xv). The unknowing of this reaching is always present, "[t]he body is always what it has not yet become" (Manning 2007: xix).

TFS participants explained that their experience of the VE had "made it far more interesting for how I would imagine the ball again" (Participant 2018d: 4). The second imagined balls came with "effervescent and changing" (Participant 2018d: 7) qualities. "I felt like I could instantly form a connection with the ball. It was larger and incorporated my movement into its shape more easily" (Participant 2018c). The participants moved more with these balls and moved with them as part of their bodies, "I could feel it inside of me, and it was like not just a ball" (Participant 2018d: 4) (see *TFS* video-document at timecode 7:12-7:16). These balls were influenced by the VE, "the visual impact and its properties of the VR ball were very strong in my head" (Participant 2018c). The experience with the technology had activated and expanded their imaginations, "I found it easier to imagine the ball once you had seen and heard the ball. You could kind of see how it worked, in terms of how it moved in the VR bit, and then you can kind of do it, imagine it really" (Participant 2018d: 2).

People have different "mental models and representation systems" (Slater and Usoh 1994: 6) of everyday reality and "corresponding preferences in (unconsciously) processing sensory data" (Slater and Usoh 1994: 6). Wanting to distinguish or separate the "reality of the perceived world from its imagistic representation" (Janowski and Ingold 2016: 3), Gibson's "ecological approach to perception has contrived to close the gap between the reality of the world and our perception of it, only by opening up a chasm between perception and imagination" (Janowski and Ingold 2016: 3). "For Gibson, the perceived world *is* the real world, as it is given in relation to a being with certain capabilities of action and perceptual

attunement" (Janowski and Ingold 2016: 3). Ingold writes, "in this perceived reality, however, there is no place for the imagination" (Janowski and Ingold 2016: 3), and there are "fateful consequences for human life and habitation" (Ingold 2013a: 2), in "cutting the imagination adrift from its earthly moorings and leaving it to float like a mirage above the road we tread in our material life" (Ingold 2013a: 2). He writes:

> With our hopes and dreams suffused in the ether of illusion, life itself appears diminished. Shorn of its creative impulse, it no longer gives cause for wonder or astonishment. Indeed, for those of us educated into the values of a society in which the authority of scientific knowledge reigns supreme, the division of real life and the imagination into the two mutually exclusive realms of fact and fable has become so engrained as to be self-evident. (Ingold 2013a: 2)

Ingold wants to "reconsider[s] the significance of imagination: to think of it not just as a capacity to construct images, or as the power of mental representation, but more fundamentally as a way of living creatively in a world that is itself crescent, always in formation" (Janowski and Ingold 2016: 3). The capacity to imagine beyond the possible, familiar or recognizable, toward the potential, the impossible, the unknown opens up this creative capacity. This opening up of a more creative formation of the world using the potential of their imaginations, an expansion from the possible, was experienced by *TFS* participants.

Once participants had exited the VE, taking off their headsets and putting down their controllers, there was a sense of a continuing presence of the VE in the physical environment through this reimagining in the final task. The VE had entered into the imaginations of the participants as a residue of the virtual forms seen and sounded in the VE. Beyond a physical engagement with the technology, the influence of the simulated VE expanded the realms of the participants' imaginations, pushing past the borders and conventions of the physical world, which had also formed borders and conventions within their imaginations.

Madary and Metzinger write about the psychological effects "that last after leaving the virtual environment" (Madary and Metzinger 2016: 1). This aspect of the technology is both considered as a positive tool for change and as a cause for ethical concern. Learning from the experiences of *TFS* participants, the ways in which they adapted their balls and how this was

highly influenced by the VE calls for the consideration of a 'post-VR' phase in any experience with the technology. A call for the requirement of a transitional phase on exiting the headset and entering back into the physical world. A residual post-VR environment is something that I investigate further in the context of creating participatory performance which incorporates VR technology. This workshop outcome has led to the development of the residue environment in *Figuring* and, subsequently, in *Soma* – as a space which operates as transitional support between the participants virtual and physical 'located-ness', and also in exploring a continuation of the potential of the virtual, rather than a reversion back toward the conventions of the possible in the physical world. Creating an after-space in an encounter with VR as a transitional environment is also considered, whereby the participant's awareness of the very nature of the transition is also brought to their (shared) attention.

Somatic Agency in the Crossings and Gaps

In the *WOS* workshops, the HMD was placed over the blindfold so that the participants could take some time to touch the headset and to then sense and feel the weight of the headset on their heads and to move to experience the physical sensation of this in their bodies before the blindfold was removed, "sensing the equipment with touch, reading it and trying to understand its form with touch. The touch and felt sensing of the hardness of the headset contrasting [with] the soft, textile fabric of the blindfold. This equipment felt like it was the bridge between the reality and the virtual reality" (Participant 2017a) (see *WOS* video-document at timecode 2:53-2:58). This activity brought the participant's attention toward the physical relationship between their bodies and the technology in its material form – its weight, texture, temperature, etc. This practice exposed the materiality of the technology and the effects of this physicality on the physical body, something that is not typically attended to in a VR experience. This activity revealed the VR technology to the participants in ways that would otherwise (in other, more typical, VR encounters) be hidden. Stelarc's performances, "exposing the interface between the body, the environment and the technology" (Giannachi 2004: 56), reveal elements of the material and functional features of a body-technology relationship. The 'exposed' materiality of the VR headset shifted in the *WOS* workshops once the blindfold was removed and the physical relationship between the headset and their bodies became transparent, bringing to the fore the visual simulation of the VE. The physical presence of the technology disappearing as soon as participants shifted their attention toward the VE, "I was so much more conscious of having this thing on my head when we put it on

with the blindfolds on, as soon as the blindfolds got removed, I wasn't even thinking of the weight of my head or anything like that" (Participant 2017b: 2).

Taking the *WOS* participants through an experience of the technology as a material, weighted object moving and sensing the HMD while still wearing the blindfold prior to revealing the VE created an attentional shift. This attentional practice, rooted in somatic sensibilities, offered the participants the possibility to become aware of and make this shift themselves. Always present, the knowing of the technology as a noticeable and physical device separated from but connected to the body, and a relation of the embodiment with the technology in which the device becomes more transparent, merged with the body. This relational movement, reliant on somatic tools, opens up participatory agency. In the pull of a visual VE with a sensory system that responds as visually led, somatic tools can offer other experiential options.

Once in the VE, the *WOS* workshop participants experienced a conscious movement of attention in moments of exposure, in which the body, technology or environment revealed itself. These were moments of a heightened sensation and experience of the perception gap between seeing and feeling and provided an opportunity for the participants to shift momentarily in their (post) phenomenological experience of the technology, forging a change in the nature of the body-technology relationship. Participants found it hard to navigate these moments, as one participant's comment highlights, drawing on a moment in the *WOS* workshops in which he experienced and explored with his partner an experience of the perception gap and which he struggled to reconcile:

> I think I touched [her] hair at one point while we had our VR sets on, and I was like, I can't really feel that. Where I think if I didn't have the VR, because we were dancing earlier on, I was much more aware of that contact, but because of all the visual stimulation, it was almost like it hardly existed, like it was quite hard to find it. (Participant 2017b: 3)

He added, "It's confusing for the brain, isn't it? That it's touching something and seeing something else, and it can't reconcile those two things" (Participant 2017b: 3). By combining somatic-dance practices and VR technology, this research investigates these perceptually confusing moments – the gaps and crossings between two co-existing environments, seen and

felt, and the ways in which these environments weave together as different realities. Within these crossings and gaps, using somatic tools, there can be an expanded sensing, new sensory territory.

Draw Me Close, written and directed by Jordan Tannahill (2020), uses VR in a narrated one-to-one experience, which is physically enacted between a participant wearing a VR headset and a performer-actor whose movements are tracked using a motion capture suit and seen in the VE by the participant. The experience uncovers a mother-and-son relationship, drawing from the makers' own experience, and uses touch/physical contact in acts of intimacy through the narrative between the performer and the participant. Wilson writes about his experience of intimacy in the work and the way in which this is mediated by the technology, "even if I felt uncomfortable or awkward during moments of the performance, I did not have to look the performer directly in the eye" (Wilson 2020: 8). In his writing about the experience, Wilson refers to:

> …moments when my attention was taken out of the narrative world and I became aware of the physical and technical limitations of the piece. Very occasionally, I noticed the wires attached to the HMD as they pulled me slightly after a sudden head movement. There were moments when the motion capture animation did not completely line up… or when I could not find the window frame as my visual perception in the simulation did not accurately correspond to the physical location of the window. (Wilson 2020: 8)

In his writing, Wilson considers the perspectives of those who "see these technological limitations as VR's failings – barriers to immersion that, once the technology improves, will lead to a greater feeling of presence in the simulation" (Wilson 2020: 8). Yet he himself experienced these moments differently, "far from being a failing of this performance to immerse me, the tactile stimuli and breaks in presence created a kind of tension between intimacy and distance that was emotionally charged but allowed me to retain my critical faculties" (Wilson 2020: 8). The revealing of aspects of the technology that were not designed to be revealed created 'ruptures' in the experience, and these ruptures were, for Wilson, a pleasurable "oscillation between intimacy and distance" (Wilson 2020: 8), allowing him to enter into the experience materially, with his body activated, not absent in his participation. In *WOS* and *TFS* workshops, the ruptures between the physical body, the

materiality of the technology and physical environment, and the simulated bodies and materiality of the VE were attended to and explored through the design and questioning of this research, and they provided openings into experiences which challenged normative expectations of the technology and perceptions of bodies and environments.

Concluding Thoughts on Difference and Inclusivity

It is not just the way in which an engagement with VR technology is designed and crafted; it is what is brought into the experience by the participant – their expectations, desires, needs from the technology, and the attentional, sensory, perceptual and embodied patterning of their body-minds – that also contributes to the constitution or building of the experience. Many of the workshop participants entered into the VE expecting or favouring the simulated visual reality of the VE over an experience of their physical body and the space in which the workshops were located. Others brought a more fluid perspective and an oscillating sense of attention between physical and virtual domains. The workshops exposed these different modes of participation and the nuanced differences in sensory, perceptual and embodied patterns across and within the different groups. These differences revealed themselves through the ways in which participants sought to find connections and make contact with one another within and across the different sensory realms and the ways in which the VR technology left residual imprints in their imaginings. There were also differences in the participants' requirements for support across both sets of workshops. In the *WOS* workshops, the partnerships between the participants within the VE and their participant accompanying guide-witness were called on, some participants seeking more touch and guidance and others needed only to be witnessed from afar so that they could move more expansively around in the VE. In *TFS* workshops, there were fewer requirements for support from the participants once they were in the VE (as non-dancers, *TFS* participants needed more encouragement and reassurance in the somatic-based physical and imagined tasks). Instead, more interventions were needed for *TFS* participants to experience the VE as a 'layered' environment rather than a 'singular' one.

I take the insights and learnings from the workshops into the next phase of practice, developing participatory performance work with VR. Considering this next step, what interests me is to find approaches and practices through which to develop performances, actively journeyed through by a participant, and this journey is underpinned by dance-based

practices and evolving these practices into performative scores. I am interested in using practices and developing scores that offer inclusive ways to be responsive to the individual needs of the participants, as well as disrupting and challenging their perceptual and embodied habits. Building these scores will involve somatic processes that tool and tune the senses and bodily engagement as modes of participation and as a means of agency and care. I draw on the sequencing of sensing tasks in the two workshops to ground the sequencing of a participatory performance journey, to centre the body and to tool and tune participants toward modes of sensing which offer a counter attentional domain to the visual VE offered by VR technologies. I do not want to dismiss the visual 'immersion' of a VE, but instead to open up the possibilities for a flexing of attention and movement between the seen and the felt and the expanded sensorial terrains which arise in this flexing and movement. The residual effects of the VE in the imaginations of *TFS* participants is a workshop finding which initiates the design, in the performances, of an 'after-space' – a residue environment on exiting VR.

The next phase of research moves into an extended practice, working with and from the body to find pathways through these ideas with fellow artistic and technological collaborators. A central element of this ongoing practice resides in notions of care – for both the human and the non-human bodies of these processes. Care is considered here, not as a structure of power, of the dominance of the technology over the body or of the dominance of one sense over another, or of the guide over the participant, but as an attentional capacity into which is incorporated a mutual response-ability (Barad 2012). A body that consciously extends becomes aware of itself as "already opened up to the other from the 'inside' as well as the 'outside'" (Barad 2012: 217). It is through this opening and extension that the body finds itself "more intimately in touch with the infinite alterity that lives in, around and through us" (Barad 2012: 217). Sensing the body in its engagement with VR technology reveals "the inhuman that therefore we are" (Barad 2012: 218) and opens up an expanded territory for sensing and, therefore, of response-ability. It is the "recognition" (Barad 2012: 218) of this alterity, rather than turning away from it, that "will help us to face the depths of what responsibility entails" (Barad 2012: 218). The practices of this research open into practices of care for the human and non-human other through extending the sensibilities of self *to* and *as* other.

> In an important way, in a breathtakingly intimate sense, touching, sensing, is what matter does, or rather what matter is: matter is condensations of response-ability.

Touching is a matter of response. Each of ‘us’ is constituted in response-ability: Each of “us” is constituted as responsible for the other, as being in touch with the other. (Barad 2012: 215)

Chapter 3

Please view the two video-documents of *Figuring* and *Soma* before reading on. The *Figuring* video was created, with cinematographer Adam D.J. Laity - to evidence the journey of the prototype performance. The video was designed specifically to bring audio-visual detail to each distinct phase of the journey and the moments of transition between them, using wide shots to locate the bodies of the participants and dancers in the different external and internal spaces. The video also takes the viewer into the space of the VE, editing this alongside the physical location in which the VR framework was housed. *Soma* is developed from the prototype of *Figuring* - and the *Soma* video reflects this shift. Created with film-maker Nina Ross, the *Soma* video builds on the previous *Figuring* video, giving more focus to the sensory and affective aspects of the experience. The *Soma* video uses close-up and point of view shots, to offer a more tactile and felt engagement with the visual, exploring the crossing between physical and virtual spaces through this sensuous engagement, rather than by locating bodies in specific spaces.

Introducing *Figuring* and *Soma*

In this final chapter, I discuss the final phase of the practice of this research project, introducing the prototype project *Figuring* (2018) and participatory performance *Soma* (2019). *Figuring* and *Soma* are hour-long participatory performances that draw on learning and insight from the two sets of workshops, *WOS* and *TFS* - detailed and thematically discussed in the previous chapter. These performative works are grounded in a moving and sensory play with the materiality of 'strings' to uncover and explore the perception gaps between the seen and the felt using multi-person VR technology. The participatory experience is shared, as four participants are accompanied and guided by four dancers across a journey through physical, virtual and "imaginal" (Biocca 1997) environments and "states of presence" (Biocca 1997), accessing and sharing different modes of perception and embodiment.

Figuring and *Soma* are distinct, substantial pieces of work. However, they operate around the same conceptual model and participant journey design. In detailing this model and journey, I will refer to these works together, other than in the specific areas in which *Soma* has been further developed significantly from *Figuring*. The participant journey for *Figuring* and

Soma was originally conceived and designed drawing on the previous workshop activity, described in Chapter Two. The two sets of workshops seeded ideas, themes and processes, which informed the way in which I thought about and started to develop the inner workings of the performances, taking key elements from these workshop processes and critical learning from the participant feedback to ground and establish the design of the pieces. *Figuring* was developed and delivered with a team of collaborators (see Appendix 1 for *Figuring* collaborators and their roles) as a prototype experience tested with 30 people in September 2018 at the University of Bristol. Following on from this prototype event, the development of *Soma* emerged through a process of critical learning through the interviews I undertook with the *Figuring* participants, the thematic analysis feeding into further practice-led investigations. The one-to-one interviews I undertook with the *Figuring* participants were rich, intimate, and personal exchanges about the memories and imaginings of the participants, accessed through embodied experiences of the work. The echoes of these conversations and the relations that existed within *Figuring* continued to be present and implicit within *Soma*.

The words of the participants were carried both physically (as large printed-out sheets) and virtually through my own memories and sensations and were delivered into the studio processes, the practices of the dancers and the processes undertaken by the creative technologists. Undertaking a thematic analysis of the *Figuring* participant feedback, combined with a change of technical collaborators, further rehearsal time with the dancers, and testing sessions with focus groups (including with visually impaired participants) led to the development and creation of *Soma* (see Appendix 1 for *Soma* collaborators and their roles).

Across the participant journey in both works is an equal emphasis placed on three key phases: i) pre-entering the VE, ii) being in the VE, and iii) exiting the VE. The key areas of development between the prototype version (*Figuring*) and the final work (*Soma*) were centred around phases ii) – in the development and testing of a new VE for *Soma* with new technical collaborators, and iii) – in the creation of a completely new residue environment based on specific *Figuring* participant feedback. In developing *Soma*, processes and practices were further developed which centred on ethical relations of care between the human and non-human 'actors' in the work – the dancers, participants, materials and environments – taking into consideration notions and practices of difference and inclusivity, which had been raised previously in the workshops.

The first part of this chapter is in two sections, which introduce and critically frame *Figuring* and *Soma* and their critical components. The first section lays out the journey model for *Figuring* and *Soma*, which draws on the previous workshop sequencing designs discussed in Chapter Two. In the second section, l frame the bodies at play – of participants, collaborators and dancers – their roles and relations. Specifically, I detail the essential role of the dancers in activating and supporting the perceptual and embodied shifts made by the participants. I outline an 'ethics of care', which is grounded in equitable structures that are embedded in somatic-dance practices and movement improvisation scores, which supported the dancers in undertaking their role. The second part of this chapter moves the reader through the three phases of the *Figuring* and *Soma* journeys, mapping each phase in detail, weaving together the collaborative practices with the thinking and practices of scholars and artists, and drawing on participant feedback from *Figuring* and from the focus groups involved in the testing and development for *Soma*.

Part One

Three-Phase Journey

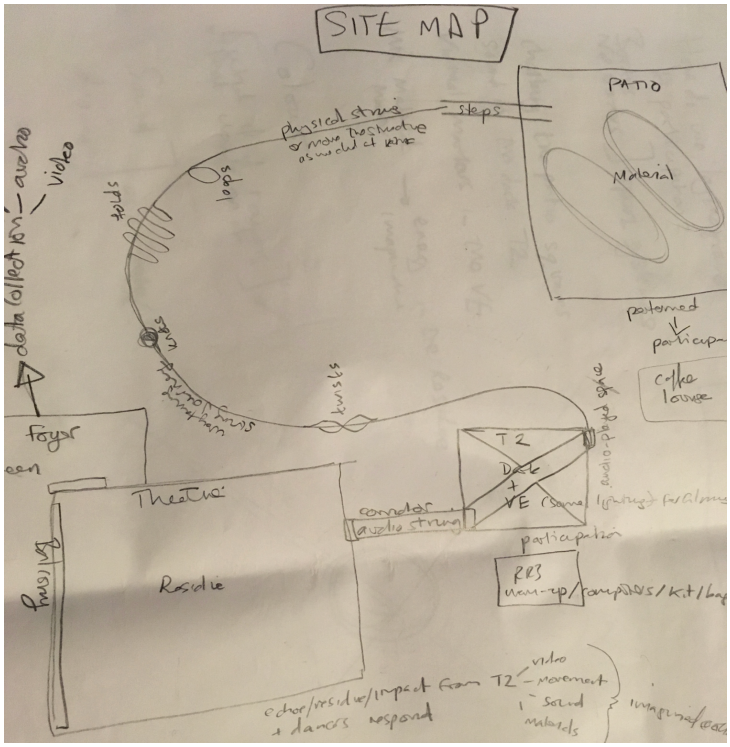


Figure 13: my original mapping out of the spaces at the University of Bristol for the Figuring journey (2018)

The framework for the participant journey of both *Figuring* and *Soma* follows a three-phase model, using somatic-dance practices and tools to underpin the ways in which the participants sense and explore the environments in which they are located and through which they move, and their relations to each other and to the dancers within these environments. The pre-VR phase uses somatic-dance methods of sensory tuning to expose and heighten the experience of the perception gap between seeing and feeling once participants are located within the VE in the second (VR) phase of the journey. The 15-minute-long visual journey of the VR section for *Figuring* and *Soma* is constituted from three key features – the VE and the virtual bodies and virtual strings within that environment. *Figuring* and *Soma* have distinct VE designs and visual flows. The VE for *Soma* was developed, taking into consideration *Figuring* participant feedback and new design ideas tested with focus groups (Bristol Old Vic, 2019). A third and final phase offers a physical framework for participants to continue their perceptual experience beyond the use of the technology and provides the opportunity for them to notice the residual effects of their experience and of the technology. This last section, post-VE, draws from the ways in which the VE strongly influenced and broadened the imaginative realms of the *TFS* participants. Early on in my research (Jan–March 2017) - I made a connection between my experience of ongoing tension and discomfort whilst being in a VE with moments of having no physical touch or connection to the physical environment. I explored practices of making contact with human and non-human bodies and materials existing in the physical environment (unseen in the VE) and, through these materials, I found different qualities and sensations of touch and support whilst I was occupying the VE. This material play, notions of touching materiality and touch between bodies, also emerged as a theme in the workshop practices discussed in Chapter Two. In place of the balls used in *TFS* workshops, strings operate as the common feature across and within the physical, virtual and imagined environments of the *Figuring* and *Soma* journeys.

Ritualistic processes for entering and exiting are used extensively in (immersive) performance practices and are beginning to be used more and more with immersive technologies such as VR. There is a growing recognition of the usefulness in extending beyond the immediate moments of entry and exit into and out of VR, processes of on-boarding and off-boarding, to support the participant experience. Interactive VR performance combining VR and binaural technologies, *Good Night, Sleep Tight* (2018), created by ZU-UK, is bookended "with a greeting and a goodbye" (Lopes Ramos 2020: 206), which "acts as a straightforward but effective means of acknowledging the participant's presence" (Lopes

Ramos 2020: 206). These connecting moments can create, for the participant, the "feel as though their experience is being facilitated with care and attention" (Lopes Ramos 2020: 206). In their writing on a post-immersive manifesto (2020), Lopez Ramos *et al.* suggest that these 'on- and off-boarding' processes can also be a means by which to set up specific physiological and psychological states in the precursor to a VE and to offer frameworks for reflection after an intensive experience within a VE. This approach is taken by Alejandro González Iñárritu in his VR installation *Carne y Arena* (translated as *Flesh and Sand*), which moves participants through three physical rooms, the middle room involving the participants' entry into a 360-degree VR environment.

Iñárritu's work is a simulation of the detention that unauthorized immigrants and refugees experience upon their arrival at the U.S. border from Mexico. Participants are first ushered into a holding cell, a space which is cold and sterile with cement floors and a metal bench, which operates as an anteroom "to slow viewers down from their thoughts and phones, to disorient them" (Capps 2018). Through overhead speakers, they are instructed to take off their shoes and socks and to put their belongings into a locker. Next, they move into and through a second space which is dark and vast and filled with sand. The participants put on a VR headset with headphones and a back unit and, through the headset, view the six-and-a-half-minute, 360-degree VR film sequence. This film is the central element of the experience, situating them in the Chihuahuan Desert amongst a dangerous but commonplace encounter between a caravan of refugees and the U.S. Border Patrol. The movement of the participants is a key element in this section, as the experience of the scene that unfolds is dependent on where the viewer situates herself, choosing whether they move among the refugees or among the officers, as "superficial lines between subject and bystander are blurred and bound together" (Capps 2018). The final room is a space in which there is time to reflect on the experience, surrounded with documentation – accounts and portraits of migrants and refugees who fled El Salvador, Honduras, Guatemala and Mexico. When I read about this work during the process of designing the participant journey for *Figuring*, it confirmed my own questioning around the possibilities for opening out an experience of VR beyond a technological context and the potential impact this extended, augmented experience could have on the participants. I was additionally interested in challenging the expectations of a prioritisation or centring of the technology in an immersive experience which uses VR. One participant's comments reflected on this opening out of VR technology in *Figuring* as part of a wider experiential journey; there was a "chaptered nature of it. I was very aware of how

much breadth and depth and richness was in all of those different phases" (Participant 2018-19: 4). The three phases of the *Figuring* and *Soma* journey offer equal time ratios and attentional resources, "the four parts felt equally balanced" (Participant 2018-19: 56).

After the title of *Carne y Arena*, the words "Virtually present, physically invisible" (LACMA 2017-18) are bracketed. Taking off their shoes and socks in the anti-chamber and leaving their belongings in a locker, the participants begin a process of leaving their physical reality behind in order to enter into the experiences of others – through the visual world of the headsets. The coldness and starkness of the first space is already a departure from the everyday, after which, once in the VE, their own bodies become unseen, forgotten as part of the experience. In contrast to this approach, the bodies of the participants in *Figuring* and *Soma* are brought into play and emphasized through the participant journey, sensed across physical and VEs, seen and unseen in different moments. Machon writes about the ritualistic practices, which are used as precursors to entering into and participating in immersive performance experiences, as "preparation techniques to gently immerse participants in the world" (Machon 2016: 40). These "pre-performance rituals and framings" (Machon 2016: 40) are in place so as "to acclimatise the interactor within the work" (Machon 2016: 40). In *Figuring* and *Soma,* these rituals are processes of priming the senses pre-VE, of tuning 'interoceptively' into the movements and sensations of the body. The methods that were used in these sensory tuning processes were drawn from somatic-dance practices and the materiality of strings, as a means through which a felt connectedness and relationality can be sensed between bodies, connected through and across physical and virtual spaces - "[a]ctivating the imagination and proprioceptive senses in such ways enables interactors to intuit their way through the event" (Machon 2016: 40).

When a participant steps into a VE using VR technologies, a perception gap opens up between seeing (the visual VE) and feeling (the physical environment). As discussed in the previous chapter, artists and technologists working with VR often try to hide this gap and to align all sensory information under the dominance of the visual as a 'single reality'. In entering into the VEs of *Figuring* and *Soma*, these gaps are exposed through the pre-VR process of tuning that the participants have undertaken and through practices of presence between the participants – who move into the visual realm of the VE – and the dancers – who remain unseen in the physical environment. These practices, which layer across physical and VEs and between seen and unseen bodies, activate the senses, re-mixing, 'synaesthising' a

"fused perceptual awareness" (Machon 2013: 203). The participants are invited to notice their sensory experience and the activation of the senses across the physical and virtual worlds, experiencing the felt unseen environment living alongside the seen visual VE. This unfolds as an exploration of the two realities and the crossings and gaps between them through movement, touch and dialogue between participants and dancers. In everyday modes of perceiving the body and its surrounding physical environment, there is little awareness of the linking or synaesthetic processes that occur between different sensory information (Synaesthesia is a medical condition when this linkage goes amiss). The brain is always compensating for gaps in perception to enable a fluid sense of reality, and the practices of *Figuring* and *Soma* expose these gaps as a first move, subsequently opening up different synaesthetic flows or transformations in the senses.

Using the immersive nature of the VE seen through the HMD and mapping it to the physical environment, Iñárritu wanted his participants to move through the vast space of the VE and to feel the sand underfoot as "a direct experience of walking in the immigrants' feet, under their skin, and into their hearts" (Capps 2018). There is a direct correlation, a conscious mapping in the design of the piece, between the spatial physicality in its vastness, the texture of the physical space in the feel of the sand on the ground underfoot, and the visuality of the VE. There is a mapping together of the physical sensation of the physical environment and the visually simulated VE. In *Figuring* and *Soma*, the physical and virtual environments are not mapped in this way, nor are they designed to be offered combined as a singular environment or reality. The physical and virtual human and non-human bodies and environments, their movement, sound and touch, continuously collide with one another - as reminders of the simultaneous layering of physical–virtual realms. These collisions are not errors in the experience; they are moments of opening in which the participants can cross between these realms and, through these crossings, notice their own perception shifting. The after-space of the residue environment, post-VR, opens up an opportunity for this flexing of perception and oscillating modes of attention and states of presence to continue without the technology.

Biocca writes about the "[o]scillations in the sense of presence" (Biocca 1997) of participants in a VE and remarks that "the compelling sense of presence in virtual environments is unstable. At best it is fleeting" (Biocca 1997). According to Biocca, the participant's attentional domain when they are embedded within a VE, affecting their sense of presence and embodiment there, is interrupted and roams between three states: "the physical

environment, the virtual environment and the imaginal environment" (Biocca 1997). *Figuring* and *Soma* use somatic and movement practices across a three-phase model to bring a physical and embodied attentiveness toward this oscillating attentional presence and the ways in which different states of presence connect or disturb the experience. The tuning practices that the participants partake in prior to entering the VE enabled them to be "incredibly present in a way that is quite unusual" (Participant 2018-19: 4) specifically, "it required my body to participate [as well as] my attention and different senses" (Participant 2018-19: 4). Throughout the journeys of *Figuring* and Soma, the participants are held in these flexing practices of attention, "there is no space to sort of be distracted by the everyday… it's rare that we're that invested in exactly what we are doing for that length of time ever, really, these days" (Participant 2018-19: 4).

The Participatory Bodies of *Figuring* and *Soma*

The dancers were "guides who initiate" (Machon 2016: 40) the participants as "interactors into the world[s]" (Machon 2016: 40) of *Figuring* and *Soma*. They set up a shared ground for participation, "[a]ctivating the imagination and proprioceptive senses in such ways enables interactors to intuit their way through the event" (Machon 2016: 40). The dancers tool and guide the participants in a somatic sensibility which brings about increased perceptual agency and challenges and disrupts normative modes of sensing, as well as pre-formed ideas and expectations, around the use of and engagement with VR technologies. These routes into participation are grounded in improvised, movement-based conventions and use modes of sensing, which challenge the dominance of visual information. In devising the ways in which dancers and participants assemble and operate together in *Figuring* and *Soma,* I was interested in finding ways to "collapse the distinction between performer and audience" (Bishop 2006: 10), to emphasise "collaboration, and the collective dimension of social experience" (Bishop 2006: 10). There are some – necessary – distinctions between the dancers and participants in the *Figuring* and *Soma*; distinctions which open up through the ways in which the dancers offer the participants their tools for sensing and guide them unseeing with eyes closed or with a VR headset on. There are also distinctions, with the dancers being unseen in the VE, moving alongside the participants who have a visual presence in the simulated world.

The "social dimension of participation – rather than activation of the individual viewer in so-called 'interactive' art and installation" (Bishop 2006: 10) is a constitutive element of *Figuring* and *Soma*, though the social element of these works operate away from the norms of everyday language and gesture; instead, there is a bodily, sensorially engaged, movement-oriented basis of communication, interaction, collaboration and play. Grant Kester writes about "participatory approaches to art-making" (Kester 2013: 27), distinguishing between "a physically responsive space (for example, one that allows the viewer to modify the space in some way or trigger a mechanical response) and the reciprocal attunement that occurs in participatory projects involving performative human interaction" (Kester 2013: 27). Whilst there are spatial, temporal, technological and physical parameters for *Figuring* and *Soma*, the set of movement scores designed to enable the participatory journey brought agency to the exchanges between dancers and participants as a creative force, fashioning the work through moments of shared sensing, movement, touch, dialogue and interaction.

The involvement of the participants is a crucial aspect in the development and performance of *Figuring* and *Soma*. These pieces come into being through the relations between participants and dancers and the materiality of the physical and virtual environments they move through. Kester writes that in participatory art, "we find a series of conscious subjects in dialogue and resistance, accommodation and confrontation" and "[i]t is in this plural relationality that aesthetic experience is produced" (Kester 2013: 28). Ben McEwan, *Figuring* and *Soma* project dancer, comments on the devising process for *Figuring* and *Soma*:

> The piece was devised alongside a lot of feedback from different groups of participants and specific individuals. So, it felt like the work was shaped both by the expertise of people [like Holly] and a more general questioning of 'How is this working for most people? What are common experiences? What are common differences in experience, and how can we accommodate them?' Making work that is accessible to a range of people and accommodating for their experiences, rather than creating a work for an imagined generic audience, then reworking it for specific groups. (McEwan 2020)

A group of dancers were invited into the project (for *Figuring,* and subsequently *Soma*), although "the group of performers involved in each phase never being the same, or never exactly the same, with some people coming when others went" (Diallo 2020). This process

was designed as a mechanism to find communicative ways by which to transfer embodied information about the works in development between the dancers. Although this way of working was really challenging, it was successful in creating a flexible dynamic within the process of creating and performing the works and gathering a collection of dancer documents (video, audio, and written) which now support the ongoing performances of *Soma*. Laila Diallo, *Figuring* and *Soma* project dancer, commented about the engagement with the participants through the various phases of the two projects development, in that it "shaped the process of score-making and our understanding of the work as it unfolded" (Diallo 2020) and the dancers in each moment of these processes "had to find words, good, useful words in order to articulate what happened and to pass on the key findings/important elements of the work-in-becoming" (Diallo 2020).

Through the development and rehearsal process, the dancers gathered an embodied understanding of the affordances and limitations of the potential for movement and interaction within each of the environments and materials within them. The presence of the technical collaborators, across the development phases of the technical elements of the project, took place alongside the movement practices and choreographic processes undertaken by the dancers. A process which "highlighted the different paces and rhythms of these specific strands of the work in developing material" (Diallo 2020), with "all the different layers of work co-existing at times" (Diallo 2020). Ghislaine Boddington and Christopher Bannerman write about the arts collective *Shinkansen*, which was set up in the 1990s, through which emerged processes of co/inter-authorship through an artistic engagement with digital technology and with (creative) technologists: "This occurred because many of the pioneering developments in digital areas were only possible through deep collaborations between those with technological expertise and those with an arts background" (Boddington and Bannerman 2008: 76), and these "interactions between new technologies and performing arts have acted as a catalyst for the understanding and appreciation of collaborative process and exchange in the arts" (Boddington and Bannerman 2008: 76). *Figuring* and *Soma* arose from an initial process of combining my practice in dance with multi-person VR technology via my own body. Developed as workshop structures, these processes of combining dance and VR resulted in critical learning through the experiences of other bodies and through participant feedback, laying the ground for me to undertake further collaborative processes in designing and crafting the participant journey of the performances. In developing *Figuring,* and subsequently *Soma*, there have been many

discussions and a sharing of practices, a "curious bumping together of individuals, groups, ideas and knowledge which becomes the engine of creativity" (Boddington and Bannerman 2008: 80), driving the process. The development of each aspect of *Figuring* and *Soma* (tech, sound, movement, participation, set design, dramaturgy, etc.) took place collaboratively, working to the overall project journey design, which oriented around the senses and the sensing moving bodies at play. This integrated way of working, of being "in the presence of other elements being made and unmade and remade" (McEwan 2020), gave the dancers "a better understanding of the history and the landscape of the work, to be able to guide participants through it" (McEwan 2020).

The invitations made by the dancers in *Figuring* and *Soma* are connected together through a series of movement scores, which draw on somatic and improvisation practices in dance. The movement scores were developed with the dancers and by testing processes with participants in *Figuring* and *Soma* focus groups. The movement scores were a shared code of practice through which the dancers could lead the participants through the different phases and transitions of the journey fluidly. Using these scores, the dancers were able to remain responsive to the present moment and also to the different requirements of each participant – with the potential variabilities of movement, perceptual and technological experience and around expectations. One of the founders of the dance form Contact Improvisation, Nancy Stark Smith, refers to a 'score' as:

> A focus, a set of parameters for improvisation. A game plan, a set of instructions/rules/limits/considerations/foci, an operating manual, software for an improvised activity. These structures can predetermine time considerations (how long, when) and space (where, how to consider it); can specify activity, relationships, personnel (how many people? who?), what to focus perceptions on, image, particulars of body use, relationship to sound/music. (Koteen and Stark Smith 2008: 28)

The movement scores in *Figuring* and *Soma* operated as attentional "filters for the experience, leading the improviser toward or away from certain actions or choices" (De Spain 2014: 35), as both a practical mechanism and a creative tool to support the movement of participatory bodies and the engagement with materiality and technology, across and within different environments (e.g. the *Loop* score, as detailed below, is a set of specific actions/invitations/rules for engagement with the string; whilst the *Zen Garden* score is more of an underpinning/holding/background score).

Loop score: Start with the loop on the ground. Two people pick it up into a simple, readable loop, no twists or turns. Keep the structure open for as long as possible. Play with this direct relationship for a while. Invite passing through in to out. Shift plane and level of loop. Shift tension of loop. Add one twist or turn. Invite more complex twists and turns. Invite tangle.

Invitations:
Raise the string over someone
Lower the string for someone to move in
Offer/invite entry into the string – raise, lower, wrap, offer, bring over
Positioning bodies in relation to the string, someone always on the outside
Being anchors (still points) and tails (movement ends)
Unison with participants – in support of actions
Always possibility/offer to come out
Offer contact with material – placing, dropping, draping, wrapping
Attention is always in and out
Attention/gaze/focus not just in but out as well, open eye contact and smiling
Change string tension
Change speed of motion
Change level of string
Give examples of how to enter, be in and exit, and also pass through
Invite a swap
Mirror participants
Playful quality
Readable experience
Invite a passing through in to out
Stand with someone and enter together
Work together as a team
Keep movement playful and readable

The scores grounded the dancers in guiding the experience, which, together with the specific and different attentional qualities and embodied experiences of each of the dancers, embedded a richness into the work. The dancers gave their own sensibilities to the flex and flow of these interconnected scores in their exchanges with the other dancers and with the participants. As Diallo remarks, "each dancer, and indeed each particular combination of dancers, will bring their interpretation, interest and experience (of this and of life) to each stage and shape the work hugely in bringing themselves to the process in that moment" (Diallo 2020). De Spain writes that "at its very core, movement improvisation is an

attentional practice" (De Spain 2014: 167). The scores developed for *Figuring* and *Soma* gave the dancers scope to work with and develop the material in highly specific ways in relation to their own practices and involvement, folded into a felt, empathetic involvement with the participants.

> Vitally we used/made scores in which either the roles were blurred, non-existent, or we could move fluidly between them. I feel this gave me a kind of simultaneous first-person and general overview of what was happening; I could experience things from many perspectives, I could initiate or respond from these perspectives. This helped give me some specific sense, some empathy, as to what a participant might be experiencing, and also to slip between 'being for', to 'being with', and maybe just occasionally 'being against' (to provoke, or suggest, to prevent, or expand possibilities) as a guide. (McEwan 2020)

The journey design that I developed for *Figuring* and *Soma* was grounded in the learnings and insights from the earlier workshops, the labs, residencies and my observations of moving sensing bodies in encounters with multi-person VR technologies. The design was materialised and enriched through the dancer-choreographic practices in the studio, through the technical processes of collaborators, and through varying levels of participatory involvement.

I wanted all of these practices to operate around the notion of the body as post-human, both human and non-human, with "no definite boundaries" (Manning 2007: 120), and opening a porosity "undermining strict measures of inside and outside" (Manning 2007: 120). The 'human' bodies of this research are involved in a dynamic interchange with the "vital materialism" (Bennett 2010) of the non-human world: Artist and technician collaborators, dancers and participants in dynamic encounters with lively materials across physical, virtual and imagined landscapes, sensed within and beyond the body's reach in an ethics constituted in 'response-ability' (Barad 2012).

Through the journeys of *Figuring* and *Soma*, the dancers operate within practices of attention, enabled through the movement scores and through their own embodied knowledge, to prepare, engage in, and reside in the effects of VR technology with the participants through the three-phase journey model. In these practices, the dancers draw from the materiality of

the environments, using touch and also verbal exchanges, to invite the participants into shared and flexible perceptions of presence. Their bodies become malleable, shifting across physical and virtual, light and dark worlds, connecting as human and non-human forms. These post-human bodies move into realms beyond themselves, expressing themselves beyond normative bodily boundaries. Barad writes that it is this "sense of exposure to the other" (Barad 2012: 217) that is "crucial" (Barad 2012: 217), as it reveals "the binding obligation that is our vulnerability, our openness" (Barad 2012: 217). No-body is autonomous; all bodies are relational and can only come into being through relationship. Processes of opening into these between spaces of relations break down boundaries between self and other, human and non-human, increasing a sense of care and empathy, as the human self is found to be deeply entangled with the non-human 'other'. As Barad writes, it is "by way of the inhuman that we come to feel, to care" (Barad 2012: 216).

When I write about the notion of care, it comes without a structure of power - and without allocated or fixed roles, that constitute "given" (de la Bellacasa 2017: 230) or "mechanical" (de la Bellacasa 2017: 230) labours toward one another. Care operates, in the passages of this writing and in the practices of this research, as an understanding of mutuality between bodies – human and non-human. It is a responsive and response-able relationship of and between bodies, as practices which "imply non-symmetrical, multi-lateral, asubjective, obligations that are distributed across more than human materialities and existences" (de la Bellacasa 2017: 231). Participants felt this sense of care in their experience of *Figuring*:

> The entire time, given the complexity and possibility of it, there was no doubt from me at any stage that we were held and looked after, and the risks were understood and being borne by the team. I think particularly at those points where you feel more vulnerable, if there was any sort of hesitation or, like, check in with you, that would have been a very, very different atmosphere. It's that sort of confidence that the participants can have in the work that was present throughout. (Participant 2018-19: 4)

In *Figuring*, the score for the dancers formed as a set of sequenced and scripted invitations, through which the participants were guided and invited to actively engage in the experience across the three phases of the journey. The sequenced and scripted invitations made by the dancers supported moments of managing the transitions between the phases of the journey,

specifically on entering and exiting the VE. In *Figuring*, the participants, in general, felt very connected to the dancers, though less with the other participants and to the group as a whole. Some participants were perhaps drawing on more conventional expectations of performer-audience relationships, and this led, for them, to this sense of disconnection, "I've talked about the connection I felt I had with my guide. It didn't build the same levels of connection between me and the other participants" (Participant 2018-19: 70). Some of the *Figuring* participants also found it difficult in some moments to communicate with one another in the VR section. Through setting up a predominately movement-based communication system in the first phase, prior to VR, the dancers had not enabled in the participants a sense of agency to 'speak'. The dancers initiated with one-way invitations for moving and sensing that did not require a verbal response or open a verbal connection with others, "you weren't part of that script" (Participant 2018-19: 25). The choreographed invitations in *Figuring* also sometimes made it challenging for the dancers to be as responsive as they wanted to be to the different requirements and desires of the participants that arose along the sensory journey. As a result of these issues, learned through the one-to-one discussions with the *Figuring* participants, a more open practice and scores were developed for *Soma.* The *Soma* scores were developed to enable the dancers to think and practice more responsively a relation of care which encompassed difference – allowing participants to each have very different journeys (if they so desired) beyond the bounds of anything pre-existing or predefined.

Synaesthetic Assemblage (*SA*), one of the movement scores developed in part initially for the residue environment in *Figuring*, was built on to form the basis of a grounding practice for *Soma* in response to the participant issues from *Figuring* and taking this notion of care into a relational movement practice. *SA* began in its development as a duet practice, one dancer with their eyes open moving in improvised exchange with another dancer whose eyes were closed. They move with a sense of one assembled form, the perceptual and embodied sensibilities of one dancer extending to encompass the other dancer, and vice versa, "[w]e both go further because of the other. Furthermore, our zone expands because of theirs. We respond as a larger self-sensing, a communion of being. Rather than narrowing the field of care, we expand it, giving further" (Little 2014).

> Our most response-able relationality is one of communion. When we track what our partner knows, we read his or her 'edges', where the tones of their comfort become blind or uncertain. We are responsible for being within this zone, which is the zone of

> their 'well-being'. They will be open and vitally engaged within this zone. (Little 2014)

In *Figuring* and *Soma*, there are sections of the journey in which there are key differences in the perceptual experience of the dancers and participants: the participants have their eyes closed, whilst the dancer's eyes remain open (see *Figuring* video at timecode 5:26-5:27); the participants enter into the VE, whilst the dancers remain in the physical environment. In these moments, rather than assuming, perhaps expected, roles of dancers as the leaders of participant followers, the *SA* practice in *Soma* invited a sharing of experiences, with no specific hierarchy or role-based format. The invitations made by dancers were verbal, touch-based and movement-oriented, and opened up a practice of communication in the group, which enabled the crossing between physical and virtual, seen and unseen environments. It is through this practice of assembling and of sharing perception that there can be an expansion of sensing beyond what is directly available to the body by accessing the environment through the body and the senses of another – a human fleshy other or a non-human stringy one. "The whole process very much raised my awareness of sorts of touch, but it was a funny one because I wasn't touching people myself, I was, like, being touched and I was connected through the strings" (Participant 2018-19: 36). In the practice of Contact Improvisation, moving with a partner using physical touch and weight-sharing as a communicable system for the dance operates with this sense of shared perception. To locate the ground through a partner's body in a lift and to expand, through connecting into their centre, to the edges of their reach. This shared perception opens the dance to new edges and spatial realms.

> When we move with our partner and as our partner, we are as response-able and 'in the zone', as are they. We both go further because of the other. Furthermore, our zone expands because of theirs. We respond as a larger self-sensing, a communion of being. Rather than narrowing the field of care, we expand it, giving further. (Little 2014: 257)

Taking on each other's experiences of extending their own embodied presence through transactions of sensing with and as other bodies and materials, the dancers and participant become intimately assembled in these expanded realities. In what Little writes about as the spaces of "communion" (Little 2014: 257) between dancer and participant, there can be ethics of care, a "kind of care to place someone in their body and to ground them but also

challenge them" (Participant 2018-19: 2). Care that moves from and through the senses in aware ways, not static or inert but lively and movable. This mutual exchange brings with it a sense of obligation, response-ability toward a partner -

> We are response-able, able to respond fully within the moment in order to support her or his well-being. We do not want to become our partner's keeper, which spells deep physical, if not political, danger. Response-ability is a far stronger relational practice. (Little 2014).

The *SA* practice in *Soma* opens up a dialogue between the bodies and senses of the participants and the dancers and the environment in which they sense – one being able to see, the other rooted in a non-visual perception. Combining together extends the sensibilities of both and opens up a synaesthetic mixing in the senses – tactile sensibilities are infused into seeing, and the visual into touch. The space around the body becomes differently available, gathered into, as part of, the shared moving, sensing assemblage.

The three-phase model for participation in *Figuring* and *Soma* invites a somatic sensibility, which offers the participants increased attentional choices in the spaces of VR and the possibilities for reflection beyond the engagement with the technology after they come out of the headset. In the practices which make up the participatory experience, the dancers operate through a series of movement scores and through their own individual embodied knowledge – meeting the participants in a shared and mutual exchange grounded in care and which resonates in shared practices of difference. The next part of this chapter follows and details the journeys of *Figuring* and *Soma* across the three phases of participation, highlighting some of the similarities and distinctions between these two works – specifically how *Soma* builds on the learning from *Figuring.* In detailing these three phases: i) pre-VR, ii) within the VE, and iii) post-VR, I bring in relevant participant feedback and draw on the artistic comparators and scholarly ideas which informed and influenced the thinking and practice.

Part Two: Bodies, Materiality and Touch in Multi-Person VR

In the second part of this chapter, I critically lay out and discuss the three phases of the *Figuring* and *Soma* journeys, opening out their similarities and distinctions. The first phase, *string-play*, is little developed between *Figuring* and *Soma*, and the discussion on this phase

of the journey constitutes practices and reflections from across both of the works. The second 'VR' phase, concerned with the participant entry into, exploration within and exit from the VR technology, is discussed with specific details on the key areas of development that took place between *Figuring* and *Soma*, based on participant feedback, working with different technical collaborators and with different (lightweight and untethered) VR technology. The areas of development for *Soma* in this VR section were centred on more inclusive and ensemble-led movement scores for the dancers and new aesthetics for the virtual environment, strings and bodies. The third section focuses on the final phase of the journey on exiting the VR headset, the residue environment, which was completely reimagined for *Soma* taking into consideration specific feedback from the *Figuring* participants and further testing with focus groups.

Phase One: *String-play* (Pre-VE)

Material play began with the exploration of different materials – sticks of different thicknesses and lengths, bendable (modelling) wire, (hemp) threads, wool and strings, different elastic materials, thicker rope and earth, as well as other (dancer) bodies, as materials and surfaces. These were unseen physical human and non-human forms to connect and move with whilst I was in a VE. Through these practices, I found that a touch exchange with another body (through practices such as following and leading with the hands and other body parts and weight-sharing techniques drawn from Contact Improvisation) took my sensory attention completely into the physical domain and away from the visual VE. This often resulted in the need to close my eyes and disengage from the VE completely in order to tune in to this touch. Conversely, exploring contact with the non-human materials did not take my attention enough; the unseen materiality momentarily caught, and then lost, in my attention. What began to work for me was to connect to another body or other bodies *through* different materials whilst in the VE. I noticed that using different materials to connect bodies – through the space and also across physical and virtual environments – created different qualities of movement and modes of communication. These explorations led intuitively toward a collective play with different types of strings – a *string-play*. The materiality of the strings provided a safe and fluid connection between bodies, as opposed to the more precarious materials, such as the sticks and the wire. The strings also offered a more nuanced movement of tension and laxation, "[t]he stretched cord, string or thread, however, retains a certain tactility: you can *feel* the tension; pluck it, and it vibrates" (Ingold 2013b: 134).

String-play forms the basis of the participant journeys of *Figuring* and *Soma* and is used to set up, in the first pre-VR phase of the journey, a material, felt, physical connectivity between the participating bodies (of participants and dancers) (see *Figuring* video at timecode 0:35-0:50).

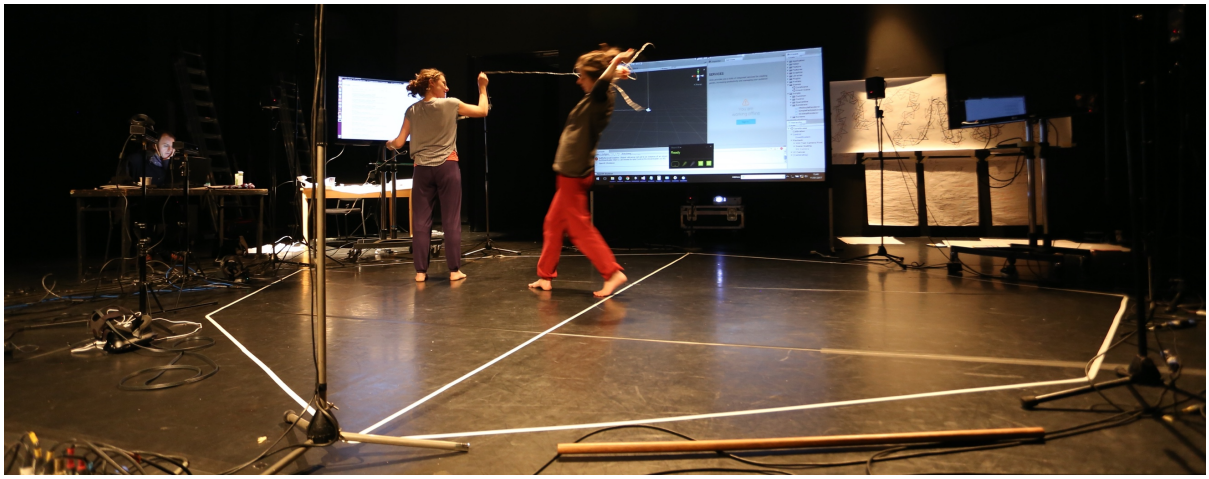


Figure 14: Lisa May Thomas and Isabel Cressy exploring materials and VR, Barbican Centre (January 2017)

Figure 15: Exploring materials in VR, Lisa May Thomas and Xavier De Santos, Bath Spa University (April 2017). Image by Chris Lewis-Smith

Developing the string-play for *Figuring* and *Soma* involved using strings of varying sizes and textures, from thin threads to thick ropes. This led to a more choreographed activity based on undertaking specific movements of the strings to create what is known as *String Figures*, or *Cat's Cradles*. Appearing in cultures all over the world at different periods of time, String Figures (SF) are a traditional storying practice using string about six feet long, the ends of which must be tied together to form a single loop (Furness Jayne 2017; 4). Using the hands, and often needing more than two hands, "[a]ll string games begin with an opening" (Furness Jayne 2017: 4), and it is from this opening that "a consecutive story follows from movement

to movement, or perhaps a touch or a word is associated with a certain turn or twist of the string" (Furness Jayne 2017: 3). In my research process, the exploration of SF was initially undertaken as a material play without bringing in the VR technology. This play led to processes of transposing the string movements from hands onto bodies and using specific movements between bodies and strings as a choreographic framework for improvisation. When a body within a loop of string or elastic faces another body within that same loop, there is a direct connection between them. The relationship is simple, in that a movement from one body can be transmitted through the string to the other in a direct line or curve. With the addition of more bodies and with a twist and turn of the loop, the relationships become more complex. Further movements – twists, turns, loops, folds and crosses – create more and more complex string formations and thus more complex relations between the human and non-human forces at play – a *Meshwork* of relations (Ingold 2016: 83).

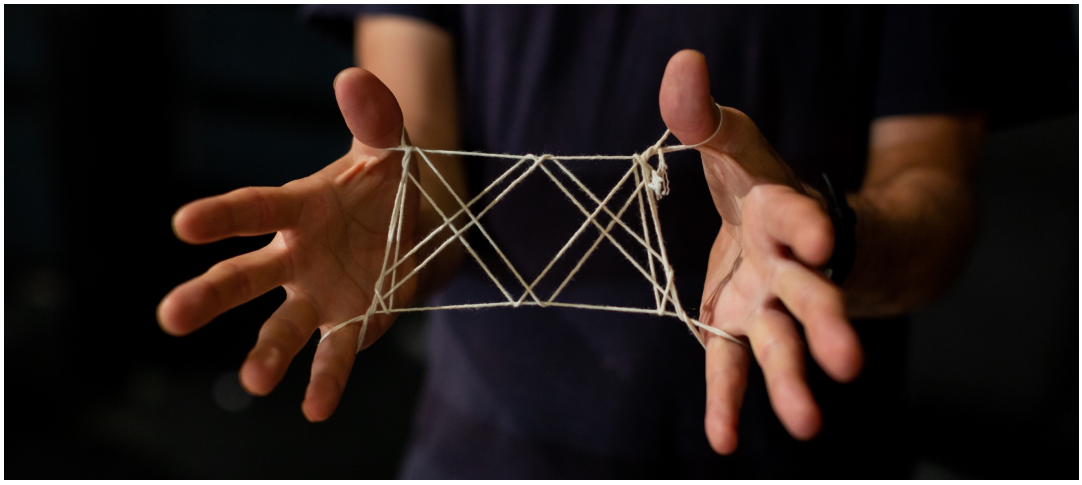


Figure 16: Apache Door String Figure

The collective practice of learning specific SFs naturally evolved into a more improvised play between the dancers. Improvisation is "a means by which to participate in a world in which conditions are always variable …about responding to and making continual adjustments" (Ingold). Practising moving together with the strings became a means by which to connect, share ideas and move in collaborative and relational ways – to agree and to disagree, to align and to challenge. The strings were "wayfaring" (Ingold 2016) lines rather than the set, linear sequences of lines that were required to produce a specific SF design. The *stringlines* came into being through a tuning into the human and non-human forces at play, the dancers moving with and within the elastics, connecting, communicating, collaborating, and enacting relationships to create each moment of the "weave and texture" (Ingold 2016: 83) of

storylines that presented themselves. Haraway writes of the complexity and of the requirement for failure in the play and storying of SF:

> Playing games of String Figures is about giving and receiving patterns, dropping threads and failing but sometimes finding something that works, something consequential and maybe even beautiful, that wasn't there before, of relaying connections that matter, of telling stories (Haraway 2016: 10).

'Dropping threads and failing' was key to the practice that was undertaken with the strings; in some instances, much time was spent unpicking and unravelling huge knots that had accumulated in seconds, with one 'wrong' twist or turn of the body or string. The failure to achieve certain outputs led to much more interesting places, places that had been previously unknown, uncharted territory. Journeying together with the strings through these improvised processes brought up new modalities for being together and for exchanges between bodies. This was more critical in the development of ideas to form a specified weave or pattern. Researching critical studies in improvisation, Stephanie Hill writes that "much of the intangible or unknowable about improvisational encounter is lost" (Hill 2013: 4) without the performer encountering failure as a means of generating "improvisational modalities" (Hill 2013: 4) and contributing to "the praxis of performer" (Hill 2013: 4).

Figure 17: Tangled String Figures play

Different kinds of string materials were used in the string-play as it evolved – from rope-like strings to finer threads, to elastics which differed in their texture, transparency and colour. Wide bands of three-metre-long loops of *Prym* elastic were decided on as the best material to work with, as they brought interesting possibilities in terms of the ways in which the movement and dance could spatially expand and contract significantly and offered bodies more possibilities for support – weight-giving into and counterbalance away from the bands (see *Figuring* video at timecode 1:31-1:45). The bright colours of these elastic bands cut through the space, offering new frames and dimensions and reinforcing the physical, tactile sensations with striking visual qualities of shifting bold lines, arcs, twists and turns as part of the surrounding environment (see *Figuring* video at timecode 1:50-1:56). The touch lines woven with the elastic occupies and pulls focus into the spaces in between the bodies. Meeting in the air, material crossings offer a tangible interchange through which participants sense each other's movements (and stillness) from across the space, perceptual tentacles stretching into and through the strings toward and into bodies and their attentions. The sense of touch is extended through the materials in a blurred reciprocity of giving and receiving and co-exists with the other senses – the sounds of the movements of strings and bodies and the visual lines and arcs created by this movement. The senses together become expanded and shared, the string-play a combined endeavour, an assemblage of human and non-human forces with a "distributive quality of agency" (Bennett 2010: 21).

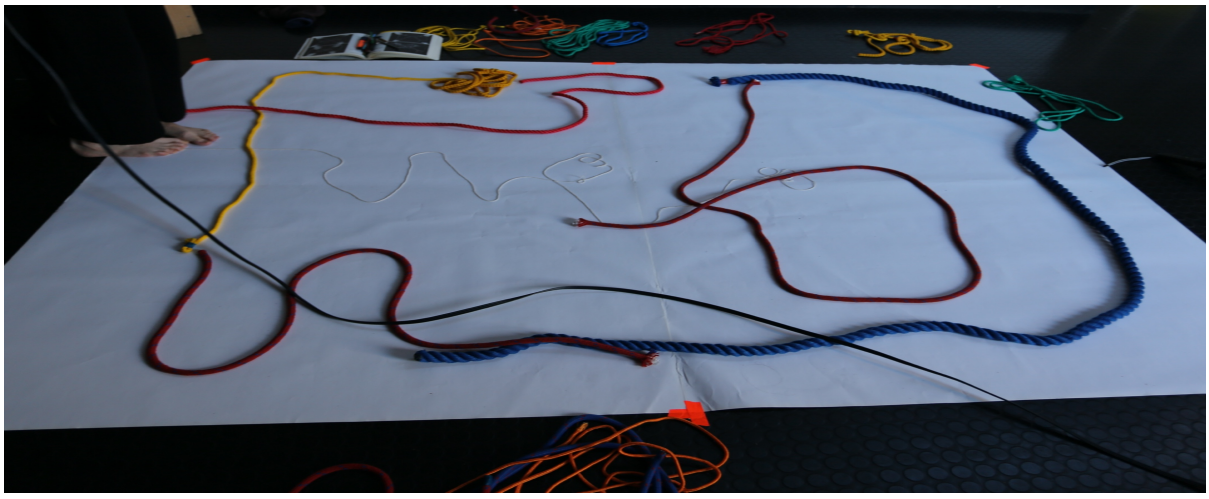


Figure 18: Early explorations with strings – Lisa May Thomas and Becca Rose at Pervasive Media Studio (2017)

Home, a SF which uses two loops of string, was created in the physical space of the studio and explored as a structure to move within. First in the physical environment, and then with one and then two people wearing VR headsets – moving attentionally and physically between

the physical environment of and within the strings and the VE. Processes of finding ways these string structures could contain and connect bodies who are in a VE, operating as dynamic physical architectures and lines of haptic communication, were investigated. These explorations combining the physical string structures with VR technology were often difficult and confusing to navigate due to the complexity of differences between physical and virtual environments. The playfulness of the SF improvisation practices that had emerged between the dancers, without the technology, had been lost. I realised that the power of these practices lay in the way in which the strings invited connection and expanded the sense of touch from bodies into the spaces between them. Akin to the sensations of connection in ensemble improvisation work and tuning scores, which explore a tactile field of attention beyond the body and of bodies as part of a relational system woven in interconnection with one another and the environment. This sensibility was lost in the strings being 'backgrounded' to technology, and I decided to re-centre the string-play as a physical phenomenon between bodies in the physical environment as a tuning device prior to entering into the VE.

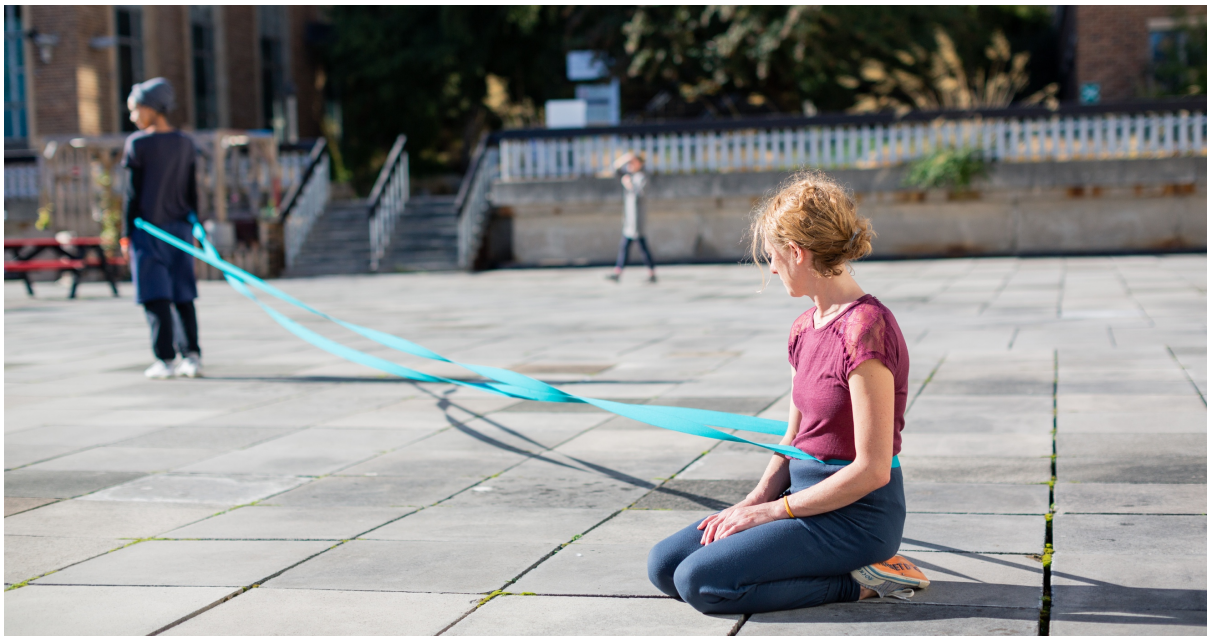


Figure 19: Rehearsals for Figuring, Lisa May Thomas and Laila Diallo

This string-play constitutes the first phase of the *Figuring* and *Soma* journey. Taking place in the physical environment, the dancers invite movement-based play, which revolves around the physicality of the strings. A collective practice which "liberates the visceral, experiential qualities" (Machon 2009: 5) between the bodies of dancers and participants, subtly drawing on sensations of touch and sound. The string-play was a crucial element in preparing the participants for their onward engagement in the journey, into the VE. Priming an experience,

the VE as a layer of (visual) sensory information, at interplay with – not dominating or layering over – the (non-visual) sensing, of the physical, felt environment, and each other's physical presence within it, set up in the string-play. In *Carne y Arena,* the first room was not a welcoming space – cold and grey, creating a specific state of mind and body prior to entering the VE. In contrast, the pre-VR experience for *Figuring* and *Soma* is one that opens up a sensory play and connection between bodies through movement and materiality. These sensibilities are called on later in the journey into VR in opening up the gaps and making crossings between physical and virtual bodies, materials, and environments.

Figure 20: Figuring prototype performance, University of Bristol, image by Paul Blakemore (2018)

Figure 21: Figuring prototype performance, University of Bristol, image by Paul Blakemore (2018)

The string-play took place over the first ten to fifteen minutes of the *Figuring* and *Soma* journeys, led by invitations made by the dancers offering a playful and improvised movement-based exchange. Using the strings, the participants felt "an urge to explore other domains of communication and expression" (Participant 2018-19: 5) away from everyday social modes of engagement. There was "the encouragement without any words to get involved" (Participant 2018-19: 35), a "silent communication" (Participant 2018-19: 5)

between the bodies and through the strings. The movement-centred interaction between the dancers and the participants transitioned "from spectating or stillness to participating" (Participant 2018-19: 48) through movement. This activity, "to move and move with people and engage with the materiality of those spaces and the elastic in some considered but playful ways" (Participant 2018-19: 48), set up the grounds for participation that participants took with them onwards in the journey.

Figure 22: Mesh by Vanessa Grasse (2016-2019), photographer: Ian Stanyon

Similarly to the string-play in *Figuring* and *Soma*, choreographic decisions are made collaboratively in improvised participation between dancers and public participants using movement scores in dance artist Vanessa Grasse's work, *Mesh* (2017). The work "unfolds through ten ensemble choreographic scores that allow the group to be self-organizing, adaptable and inclusive" (Grasse 2019: 60), each score supporting the direction of a central movement activity occurring between bodies at any one time: activities of "building human 'arches', making movement 'currents', building human 'nets', making 'architectural lines', making 'transformative lines', hugging and weaving, and building human walking bridges" (Grasse 2019: 60). The *Loop* score, developed for *Figuring* and *Soma* with the coloured Prym elastic bands, is a series of invitations made through the strings between dancers and participants, and which are open and inclusive. The invitations are placed along a rough trajectory, signposting a building of dynamics in the movement of bodies and complexity of stringlines – starting from a single loop and moving into more complex weaves and patterns.

Using the *Loop* score, the dancers encouraged a wide spectrum of movement, from small micro-manoeuvres and gestures to large, sweeping collective and collaborative motion: "[we] stood, walked, wandered, picked things up, people kind of walked at each other and then veered off or… and we held onto things, felt the tension in it, maybe made it move together or separately" (Participant 2018-19: 28). There were simple, more gestural movements such as "strumming and weaving" (Participant 2018-19: 1) the materials, to more physical actions with the strings, such as "stretching them and kind of making shapes with them, pulling apart, running through …wrapping people up, twisting them, sort of high and low around your feet, around your torso" (Participant 2018-19: 33). Participants acted as anchors, still points for movement to take place around, "[I] became the centre of the sort of maypole structure, that kind of allowed us all to kind of climb in, wrapped around with the thick elastic" (Participant 2018-19: 35), whilst others were the moving parts around these structures (see *Figuring* video at timecode 1:38-140).

> I think what stuck with me is that running around with an elastic band, and with the other person holding the other end of the elastic, actually again joining in and taking part in my experience of it and allowing me to experience that. Me allowing me, but also him joining in that experience and not putting any constraints. (Participant 2018-19: 7)

Crucially for the onward journey, this first phase of activity in *Figuring* and *Soma* enabled the participants to gather a physical and tangible sense of their connection to one another through the strings. "Transferred through the tension of the elastic, you feel a human body" (Participant 2018-19: 5). The elastic strings had a "thing-power" (Bennett 2010: 2), enabling dynamic movement through space, the sharing of the weight of the body through counterbalance with another through the string loop, and offering qualities of tension and slackness. "When it's been pulled and pushed and tugged, you are actually still feeling the physicality of somebody else through the tension of the elastic and so there's that communication there through movement and tension" (Participant 2018-19: 5). In Grasse's scores for *Mesh*, the connections are mostly found through direct touch and "on counterbalance or weight-sharing techniques between multiple bodies" (Cassani 2019: 81). In *Mesh,* touch forms "[t]he group structures and body patterns that emerge and dissolve" through the environment, "the site within which it is performed and passes through" (Cassani 2019: 77). In the string-play for *Figuring* and *Soma*, it is the bright elastics that pull focus in

the spaces between bodies, enabling visually and haptically a sense of touch between them. The strings enliven the spaces between the bodies of the dancers and participants, forming touch lines and mediating movement-based communications between the bodies – leading and following, giving and receiving, sustaining and shifting.

Figure 23: Soma at Bristol Old Vic (2019), image by Leticia Valverdes

Figure 24: Soma at Bristol Old Vic (2019), image by Leticia Valverdes

The material play in the first part of the string-play in *Figuring* and *Soma* was centred around creating very physical sensations of connection in the group, reinforced through the visual lines of colour twisting and stretching out between the bodies in the space. The use of the thick elastics enabled this physical sensation of connection, the push and pull of the elastics against the body – the hands, arms, legs and torso. In contrast with the colour and weight of the bands, the participants experience a new material string – a fine, stretchy, and transparent 'jelly string' – which is introduced and given to participants as the next part of the string-play

section. The jelly string requires a finer attention, the participants needing to move it with a lighter and more delicate handling, with their fingers and thumbs rather than with their hands and bodies. The transparency of the jelly string also reduced the visual aspect of the earlier string-play with the elastic bands, tuning the participant's attention further towards their other senses. The dancers invite the sounding of this "almost invisible string loop, which people would hold to their ears and twang" (see Figures 25 and 26). This enables an exploration of the relationship between the ways in which the participant's move the strings and the sound that is produced through this movement, an aspect that is explored later in the journey in the moving and sounding of virtual strings in the VE. Intensifying the relationship between movement, materiality and sound, Ellen Fullman's *Long String Instrument* (2015) is sounded as the musician-performer moves along it; the sound exists and is embedded in an assemblage of the movement – the performance – of the player and its materiality. "This large-scale work consisted of 70-foot-long metallic wires, anchored by a wooden resonator, across which the performer moves back and forth with rosin-covered fingers. The overall effect has been rightfully compared to the experience of standing inside an enormous grand piano" (Fullman 2015). As with the *Long String Instrument*, the string-play with the jelly string provided the participants with an entry point into the materiality of the string via movement, de-centring the visual aspect of it and requiring collaboration.

Figure 25: Sounding the jelly string in Figuring, (September 2018, University of Bristol), image by Paul Blakemore

Figure 26: Sounding the jelly string in Figuring, (September 2018, University of Bristol), image by Paul Blakemore

The sounding of the jelly string brought the bodies of participants and dancers closer together, into more intimate proximity with one another (see *Figuring* video at timecode 2:23-2:27). Using this mechanism, the participants are gathered by the dancers within the loop in preparation for walking together (see *Figuring* video at timecode 2:46-2:49); a walk in which the participants, with their eyes closed, are led by the dancers (eyes open) holding onto the looped string in each hand. Building connection between the participants and dancers in the earlier string-play supported the sense of trust required in the dancers for participants to close their eyes in the walk. In "gradually encouraging us to play in that space" (Participant 2018-19: 52), there was "the kind of lead in that you one hundred per cent needed to get people to expose themselves comfortably" (Participant 2018-19: 52) and also "to feel like they've taken agency over their own exposure" (Participant 2018-19: 52). When it came to the moment of inviting the participants to close their eyes, "I was wholly in it. I was totally trusting" (Participant 2018-19: 52). As Machon writes, "[f]ull immersion always involves degrees of interactivity and improvisation on the part of spectator as much as artist, which must be shaped expertly by the practitioner" (Machon 2016: 37). The string-play had initiated a mode and level of engagement and play between the participants and dancers which enabled them to move, guided, through an environment with their eyes closed. The bodies of the participants were contained within the loop of jelly string as they walked, and they were able to subtly sense one another through the movement and sense of tension or laxation of the string. The loop of string connected them together, as a collective whole, an assembled body, "we were holding onto these threads between us. We were in a line, and we were holding on to those threads, and that was our new kind of parameter" (Participant 2018-19: 56) (see *Figuring* video at timecode 3:47-3:50).

Figure 27: Figuring eyes-closed walk (2019)

The eyes-closed walk was developed from the use of blindfolds in the *WOS* workshops. To be invited to closed the eyes, "it was nice to be given the option… something about free-will" (Participant 2018-19: 1). The invitation to participate in a voluntary blindness, in closing the eyes, rather than putting a blindfold on, gave the participants a sense of increased agency and also responsibility. Choosing to close their eyes became a continued investment into the experience, "[I was] having to really work hard to keep my eyes shut" (Participant 2018-19: 42) and "I was having to work at staying with it and staying present" (Participant 2018-19: 42), as "the urge to look was really strong" (Participant 2018-19: 42).

> I was much less inclined to peek than I would have been in a blindfold. Because it is quite an unnerving and disempowering experience to be asked to walk somewhere you can't see that you're safe and it was up and down and round and about, and I suspect all of those things feel exaggerated when you're not looking …there were points of considerable difference that it would have been possible to go, 'ahh, I just need to look'. (Participant 2018-19: 1)

The eyes-closed walk enabled the participants to shift their sensory processes away from the visual and toward a non-visual sensing. Tuning into the external sensations of the environment – of touch, temperature, sound and the light on the backs of their eyelids; and to interoceptive, internal sensations, such as an "awareness of stillness and movement and breathing" (Participant 2018b: 8), somatic sensations, "subtle understandings about how you feel about your body" (Participant 2018-19: 2). This sensory shift was designed as a

precursor to participants entering into the VE, to support their experiences of the perception gap by providing access to the non-visual world and to non-visual connections between the bodies (of participants and dancers) and to the physical environment, which would therefore remain present and available to them on entering the visual world of the VE.

Figure 28: Figuring eyes-closed walk (University of Bristol, September 2018). Image by Paul Blakemore

Closing their eyes required participants to place their trust in the dancers who were leading them, to trust them to caretake their physical safety as they moved through the environment, "they felt like a spiritual guide, almost an extension of self, that looks out for you and leads you, someone you can trust" (Participant 2018-19: 69). During the walk, some of the participants "felt quite vulnerable and my body felt quite exposed" (Participant 2018-19: 40), and it was the presence of the dancers, the "gentleness of …someone taking care for you" (Participant 2018-19: 65) that enabled them to feel "safe" (Participant 2018-19: 6) and to remain open to the experience, despite the challenges. For some of the participants, the experience was quite freeing, "it actually amazed me how much I enjoyed that sensation of giving up control of navigating a space and experiencing it completely differently" (Participant 2018-19: 16). Laila Diallo, one of the *Soma* dancers, commented from her perspective on this aspect of the participant journey as one which was "a standout moment in terms of performance practice" (Diallo 2020).

> The negotiating of being with them while also giving them space to be alone in the experience... The negotiating of when to guide with touch... how to touch... when to speak, or not... There is/was so much at play in that task around empathy and sensing. And a balance between care and allowing some discomfort, some dissonance to allow for perhaps new/different 'consciousness', sense of being in/of an environment. (Diallo 2020)

Figure 29: Soma at Bristol Old Vic (2019), image by Leticia Valverdes

Phase Two: (VR)

Layered Perception and Participation in the VE

In the transition between the first and second phase of the journey for *Figuring* and *Soma,* from the material environment to a virtual one, the participants shift from the eyes-closed walk, which takes place outside, into an interior space that houses the VR technology. Relocated in this new environment, the participants continue to keep their eyes closed whilst, with the guidance of the dancers, they put the VR headsets on. In these moments, drawing from the *WOS* workshops in which the participants kept their blindfolds on under the HMD, the *Figuring* and *Soma* participants are invited, with eyes closed, to notice and attend to the materiality of the technology – the weight of the headset on their heads, the touch, texture and temperature of the techno-materials. The sensory tuning to the non-visual still at play from the walk, now in the domain of the technological space. The dancers remain present with the participants, continuing a relationship of presence which operates in the non-visual realm, critical in the functioning of the eyes-closed walk and subsequently in this transference to the VE, "going from one piece of sensory deprivation to another" (Participant 2018-19: 2).

The participants enter into the VE and gradually become engaged in this visual realm, whilst the dancers remain unseen and present only as part of the physical environment. In the VE, the relationships and sensory tools that were built through the string-play and eyes-closed walk continued to be present as powerful aids to support the transition into a continued sensory deprivation with the VR technology, "trusting with your eyes closed into a quite disorientating virtual space was a really heightened sensation and trying to find comfort within that and have that quite clearly stewarded by the people that were leading us" (Participant 2018-19: 2). The dancers offered guidance and support to the participants within the VE, and they also challenged and disrupted the VE through their physical presence. The perception gap was accentuated through the exchanges between dancers and participants, which brought about a shifting focus between physical and virtual relations, bodies and environments and a continued experience of the sensory awakening that had been instigated through the string-play and eyes-closed walk. "My guide was great. They gave me a real sense of somatic power. The way they handled their relationship to the participants was amazing, building play and trust" (Participant 2018-19: 69).

The VR section of the participant journey was developed for *Soma*, with learning from the feedback from *Figuring* participants, with a change in the type of VR technology used (*HTC Vive Pro* VR was used for *Figuring* and *Oculus Quest* VR for *Soma)* and working with new technological collaborators. The design of the different VR technologies, from those used in *Figuring* to those used in *Soma*, impacted on the participatory experience and also on the ways in which the dancers were able to guide the participants into and out of the VR headsets and support them whilst in the VE. The untethered *Quest* VR technology offered a much more lightweight and flexible handling to the *Vive,* which was tethered with thick cables running from the back of the HMD to the computer. In *Figuring*, the dancers found their time was mostly spent, in this VR section of the journey, operating as safety stewards to ensure there were no trip hazards or collisions. In *Soma*, with the absence of wires in the space, the dancers were freer to attend to the movement-based scores and to follow different participant requirements and desires during the VR section of the journey. The development of a new visual journey within the VE was created for *Soma* with new technical collaborators – VR creative technologist Clarice Hilton and creative technology studio, All Seeing Eye. These developments left behind the molecular VE content and framework, which was used by previous technical collaborators from the University of Bristol (led by Dr David Glowacki), and which had added an additional and unnecessary layer of complexity to the participant

experience in *Figuring*. With these changes, the activity of the dancers was less limiting in the VR section of the *Soma* journey and opened up possibilities for ensemble-oriented practices to occur between the dancers and the participants. This collective activity encouraged a more collaborative environment during the VR phase (rather than participants operating through their own individual interactions in the VE). This also opened up a continued sense of collective and collaborative interaction in the final phase of the journey.

In the moments of transference from the physical to the virtual, putting on the HMD with eyes closed and opening the eyes to the VE, the dancers operated through a practice in *Figuring,* which was modified and developed for *Soma*. These developments were based on *Figuring* participant feedback as well as further rehearsal sessions and testing with focus groups of participants (at Bristol Old Vic). In *Figuring*, the participants were led through a choreographed sequence of invitations as a one-to-one engagement with an allocated dancer-guide (see *Figuring* video at timecode 5:29-5:42). *Soma* opened up these interactions as a more ensemble-oriented and open score (see *Soma* video at timecode 5:23-5-36), the dancers operating with a toolbox of verbal, touch and movement practice through which they could operate more responsively, bringing the participants into an engagement with them and with the work as active co-creators. These differences, between *Figuring* and *Soma,* enabled the connectedness within the group, achieved through the string-play, to continue into the VR section. The sense of group communication and flow had been lost for many of the *Figuring* participants in the shift from outside to inside, from physical to virtual, "I remember the VR space as being a much more isolated experience than the previous two" (Participant 2018-19: 12). The opening into the *Soma* VE was initiated by the dancers sharing a reading of *Anchor* score, written by Will Dickie (*Figuring* and *Soma* project dancer), prior to opening their eyes into the simulated world. As a metaphor for the perception gap between seeing and feeling, between the participants (as seen) and the dancers (as felt/unseen), *Anchor* made explicit the relationship and support that existed between the dancers and participant in the first moments of this VR phase of the journey, guiding their entry into the VE as a layered experience.

Anchor score
Here's your headset, keep your eyes closed for now.
When you open them, we will stay with you in this physical space.
As well as making sure you're safe and don't bump into anything, myself and the others have a task.
To follow and to dance with the movements of your attention.
This means we might ask you questions or make physical contact.

Like an anchor on a ship, you can't see us, and you might feel at times we're holding you back, or you might forget that we are here altogether.
But we will still be here, and we will be moving.
And when you take the headset off, we can see or feel what remains.

Opening the eyes from a long phase of darkness into the VR was like "waking up" (Participant 2018-19: 43), "it was a really, like, arresting experience to be suddenly sort of awoken but in a different reality, which was very powerful" (Participant 2018-19: 1). The *Figuring* participants who had previously experienced VR commented that they had "never come across that [going into VR from the eyes closed] as a mechanism before" (Participant 2018-19: 1), that in their previous experiences of VR "you go in a very abrupt way from being in the real world to being in the virtual world" (Participant 2018-19: 17). Opening the eyes in the VE from a relatively long period of darkness necessitated a sensory readjustment. A reorganisation of the senses to include the visual information of the VE, alongside a continuation of a non-visual sensing towards the unseen dancers and the physical space they remained present within.

> It made kind of entering the virtual world less of an abrupt transition and more of a gradual metamorphosis. And it made me more accepting of it perhaps like when you've got visual information again, it was obviously very different to, you know, real-world visual information, but because you'd been slightly deprived of it for a while, it was kind of you were a bit more, I don't know, alive to it. It's sort of sensual pleasure. (Participant 2018-19: 17)

This synaesthetic processing brought the participants into a full attendance of their senses; they had an awareness of the re-pivoting of their senses to include, and ultimately of the adaption back to the visual, a recentring of vision. Their experience of a sensory awakening is akin to, as Machon writes, the "sense of being alive – more significantly, an awareness of the lived moment" (Machon 2016: 39). The visual deprivation into the VE supported this heightening of sensation and awareness of sensory organisation,

> By heightening those senses often deemed as secondary – smell, taste, touch, hapticity. In turn, touch and haptic perception enable the interactor to be sentiently engaged with the world. At the points one is sighted, one is encouraged to look and look again. (Machon 2016: 43)

During the VR section of *Figuring* and *Soma*, there is an invited play, a conscious moving of (sensory and therefore perceptual and embodied) attention, between the physical environment and the VE. *Figuring* and *Soma* are not immersive experiences, in the sense that the participants are not encouraged to 'drop into' the VE. Rather, they are tooled in a somatic, non-visual sensing and invited to explore this alternative mode of sensing whilst in the VE, and which pulls them out of the immersive nature or affordance of the visual simulation. The dominant sensory attentional pull of the visuality of the VE is disrupted by the invitations made by the dancers, which draw from the non-visual sensing accumulated through the previous string-play and eyes-closed walk. The presence, words and movements of the dancers remain as part of the physical environment, as the participants look, move around and interact in the VE, creating a layered experience and the opportunities for moving between and across the layers. The participants followed their curiosities, led by their sensory sensations of sight, touch and sound, belonging to the different layers or environments. The capacity for each of the participants to shift their sensory attention across the environments in a conscious way was varied across and within the groups and reflective of the differences in the *WOS* and *TFS* workshops. The crossings between physical and virtual bodies and worlds were fleeting in some moments, and at other times more sustained, sometimes sensed by individuals and at other times shared. For many of the *Figuring* participants, vision returned to its dominant status, taking its precedence in the senses, and subsequently, there was resistance to the invitations made by the dancers who, with their very presence in the physical environment, disrupted the visual flow, or pull, of information being received by the VE. "[You were] forced to put most of your attention into the real, the physical world" (Participant 2018-19: 20), and "I was trying to stay mostly in the virtual space …it was like trying to focus, and then you're being sort of forced to divert or split your attention" (Participant 2018-19: 20). For other participants, the physical environment remained heightened after the string-play and became integrated as a more layered sensorial experience in relation to the VE. The participants who experienced the physical reality more strongly as a layered experience with the VE recalled physical after-effects, "the movement kind of sensing part of it" (Participant 2018-19: 58), the "invitation to be allowed to move" (Participant 2018-19: 58) which "heightened the senses in the body" (Participant 2018-19: 58). "I remember the people around me, and I remember the space, and the gaps. The people around me …not... the virtual experience wasn't really what stuck with me" (Participant 2018-19: 56). It was the sense of "these other bodies that were present with me" (Participant 2018-19: 50); the experience was "synaesthetic" (Participant 2018-19: 50).

> I have a very physical recollection of what it is like, particularly to be guided and touched by people that you can't see. That was a really striking component of that piece. I am relatively familiar now with seeing other people in VR, and generally that means avoiding walking there – that's usually what that gives you, so to be doing something with them collaboratively was so generous and interesting, but it was the bodies unseen that has stayed with me most, all of those things about the physical space, I still don't really have a reference for, has struck me as a really extraordinary way of feeling. Inevitably, with that kind of thing, every touch is incredibly heightened when I don't have a visual reference, or I can't check it, in terms of the audio or the visual, as I am already engaged in this other space. So, to have those two realities playing in real-time, how that felt and how much potency and potential that feels like it has for the form, which is so focused often on what is the visual [and] what is the sort of empathy being generated by this picture of a thing that I am looking at. [The] attention to the body and acknowledgement of those two spaces co-existing, I thought, was really quite profound. (Participant 2018-19: 3)

The relationship between the bodies of the dancers and the bodies of the participants, which crossed between physical and virtual realms, created "what felt like quite a strange dynamic between the seen participants and the unseen performers" (Participant 2018-19: 2). These participant–dancer relations perhaps "the inverse from what you might expect from a theatrical performance" (Participant 2018-19: 2). The open invitations to explore and play with the strings in the VE and somatic interventions in this process made by the dancers subverted conventional modes of relating in performance experiences and left some participants feeling unsure as to "where to put my focus or to whom to pay attention" (Participant 2018-19: 2).

The participants in *Figuring* and *Soma* are not spectators of performance; they are active and agential interactors within an immersive performance scenario. Using the movement scores and pre-VR string-play, the dancers laid out foundations and conventions for relations not based on fixed or pre-ascertained ideas but on the notion of a continual becoming of and between bodies and strings in environments. The creating of the experience arises through a continual "awareness of one's condition of interaction with others" (Braidotti 2006: 4) and in "one's capacity to affect and to be affected" (Braidotti 2006: 4) through "[t]he bodily self's

interaction with his/her environment" (Braidotti 2006: 6). These interactions are "[n]egotiations …stepping stones to sustainable flows of becoming" (Braidotti 2006: 6), and through which different capacities in the "body's conatus or potential" (Braidotti 2006: 28) can become available. Braidotti writes about the "nomadic ethical stance of a post-human subjectivity" (Braidotti 2013: 51) as that which is "materialist and vitalist, embodied and embedded" (Braidotti 2013: 51). Citing Haraway (1985), Braidotti brings attention to the way in which "the machines are so alive, whereas the humans are so inert" (Braidotti 2013: 58), an emerging state of relations between bodies and technologies which I seek to challenge through this research.

In the use of VR technology, there are issues of care that need to be considered; in the handling and use of the technology, in the moments of entry and exit in the VE, and the content of that VE, and in the need for a transparency of relations at play in the room. The participant needs to know who else is in the room, participating or watching; and whether there is a guide with them – who that is, what their role is, and there being a way to support a sense of trust in this person and in the set-up of the space and the experience as a whole. This information can help to support a participant's experience, giving them a sense of trust in the handling of the experience and the key relationships within it, as well as in their exposure to and participation in the content of the VE. In many VR experiences, the notion of care is broadly equated with ways in which to minimise risk. Considering factors such as safety from physical hazards and, in advance of the experience, making participants aware of issues that may arise during their experience, such as motion sickness, disorientation, dizziness and so on. These practices with VR, whilst still essential to safeguard both the participant and the artist/technologist/creator, operate around constructs and contracts of care that are fixed and offer little room for flexibility to respond to other, different needs that may arise for participants. Working to a fixed set of rules to support or care for participants in VR/technologically mediated experiences reduces the liveliness of the relations, e.g. between human participant and human guide, or between human participant and non-human content. This approach suppresses the means of a political and ethical agency that humans need to attain in our technologically mediated world, to challenge the increasing agency of the machine versus the passivity of the human. My experience of VR piece, *We Live in an Ocean of Air* (Marshmallow Laser Feast experience, Saatchi Gallery, Jan 2019), was lacking in the sort of care I seek with VR, which offers this liveliness and responsivity between bodies and technologies:

> Participants wait, watching those before them experience the VE, anticipating that they will too, soon, be watched by others they do not know and are not able to see. In an abrupt and quick change-over, I am harshly placed into a backpack and sensors are wound over my ears. There is barely a 'hello' and certainly not an introduction. I do not know who is 'outside' looking after me or over me, I do not even know if anyone is there. The audio recording starts. The smooth voice overrides for a moment the exterior noises, softly telling me to take a breath. I can hear a woman talking loudly and frantically in another language, Russian? It takes me sometime to realise it is coming from the physical environment. I find myself worrying about what is happening in the physical environment. There is no-one around to connect with, I speak out to my colleague – "Emma, are you there", "yes" she replies very distantly. I try to move toward her. The visual environment is becoming increasingly intense, the visual environment shifts through different visual states at a rate which leaves me behind. There is no time to breathe. I am on my own in the experience, yet there are many people around me. I feel disconnected. (Thomas, autoethnographic writing on We Live in an Ocean of Air Marshmallow Laser Feast experience, Saatchi Gallery, Jan 2019)

We Live in an Ocean of Air exposed, in my experience of it, a lack of consideration of care for the participant. There were very few physical connecting points for the participants beyond the get in and get out of the technology, and, in the course of the experience, my body and other's bodies became passively absent, not called on to participate or be lively. The physical co-presence of the other participants, the guides, and those who were watching was backgrounded, not attended to. A brief pre-recorded audio section introduced the work at the start of the experience, inviting participants to take a breath, felt like a momentary consideration of body and presence, but these sensations were soon consumed by the visual effects and thus the loss of the body. The gallery stewards handling the installation and caretaking the physical space offered no words or gestures beyond their functional operation of the space and the technological equipment within it. The sense of being part of a group of people all taking part in the experience together was lost in the non-ability to see them in the VE, and there being no other moments or means for connecting together. In *Figuring* and *Soma*, I had the strong desire to address this lack of care that I experienced and really wanted and needed in *Ocean of Air.* Opening up practices for attending to bodily presence and the

relations between bodies situated across both physical and virtual domains is a central aspect of the VR experiences I have created for this research. In these experiences, taking one or two breaths is extended beyond an introduction and incorporated as a practice of somatic sensing, which becomes available as a relation of presence throughout.

In developing and creating *Figuring* and *Soma* and drawing from the workshop practices discussed in Chapter Two, my work with technology places the technology of VR as part of a broader journey. This journey encompasses the space-time prior to entering, and also after exiting, the headset. I use these expanded moments of before and after to tune and enliven, in the participant, a fluid and dynamic relationship to the technology and toward each other and the materiality of and within the environment. This tuning increases the participant's sense of agency – to move, sense and act within the work; and builds responsive relations of trust and support between the groups of participants and dancers. Accessed through a felt sensing of their presence and through touch and words, the dancers for *Figuring* and *Soma* bore witness, supported, and guided the participants, and in practices of assembling with them, invited, challenged and disrupted the flow of their participation (see *Figuring* video at timecode 8:24-9:19). Moving and sensing in lively relations with technologies, "[y]our body will thus tell you if and when you have reached a threshold or a limit" (Braidotti 2006: 5). The participants, with their own agential powers, moved freely and met their thresholds; the dancers were with them, reading their edges through a synaesthetic assembling, mutually held in a response-ability of care. The dancers did not operate outside of the work, peering in as instructive aids, they were embedded within it, and their involvement guided by the actions and sensibilities of the participants, co-creating and shaping the world of the piece through the passing of the duration of the journey.

With many of the newly developed social VEs, the code of participatory conduct is left to being set and followed by the individual, emphasising individualistic thinking as opposed to a collective or relational notion of care. Ethical implications for bodies in VEs are now being considered more deeply within the field of social VR (e.g. with Cortese and Zeller's work). What is needed are ethics that are relational, lively and dynamic and which centre care, not as a power structure but as an agential force between bodies, as Braidotti writes:

> A radically immanent intensive body is an assemblage of forces, or flows, intensities and passions that solidify – in space – and consolidate – in time – within the singular

> configuration commonly known as an 'individual' (or rather: di-vidual) self. This intensive and dynamic entity does not coincide with the enumeration of inner rationalist laws, nor is it merely the unfolding of genetic data and information encrypted in the material structure of the embodied self. It is rather a portion of forces that is stable enough – spatio-temporally speaking – to sustain and to undergo constant fluxes of transformation. (Braidotti 2006: 5)

Slater remarks, "we need to think about whether we would want to have this experience – without prior warning, education, training, and assured compliance with a generally agreed and debated code of conduct" (Slater 2020), following The Golden Rule of Reciprocity (Negative Form, Hillel): "That which is hateful to you, do not do to your fellow" (Slater 2020). My research, drawing on Braidotti and fellow post-humanists, asserts the need for a thinking which expands beyond a binary self–other scenario to bodies as transformative, in continual flux with, and as one another and the environments that surround and penetrate through them. The practices within *Figuring* and *Soma* invite exchanges of relations which enliven a felt sensing within the body and, from this, a felt relationality between bodies and the environment.

The Visuality and Interaction of the VE

In contrast to the *Figuring* VE, which was a dark and relatively featureless space (see *Figuring* video at timecode 7:27-7:31), the *Soma* VE (see Figure 30) was designed to offer some aspects of an actual environment, with a ground and sky separated by a horizon and subtly shifting in state (of light/colour reflecting shifting time) (see *Soma* video at timecode 7:03-7:09). As a "'doing', 'verb-space'" (Kozel 2007), the *Soma* VE was designed to create a feeling of expansiveness, affording a sense of reach and movement out into that world. The ground, a blue-black colour, subtly shifting so as to create a textural, tactile quality, and the sky gradually changing in colour and light from dawn to dusk, which offered a sense of time passing, the beginning and ending of this phase of the journey.

> It is planet-like, isn't it? Like continents and seas shifting, and I can see some string, and it feels like a horizon line, very much a pink sunset and then blue and sky. I can see some little, I don't know what that is, but I can see some little stars flickering, a

little ball of stars here and then I can see a ribbon right here, a yellow band, (Participant 2019b: 7)

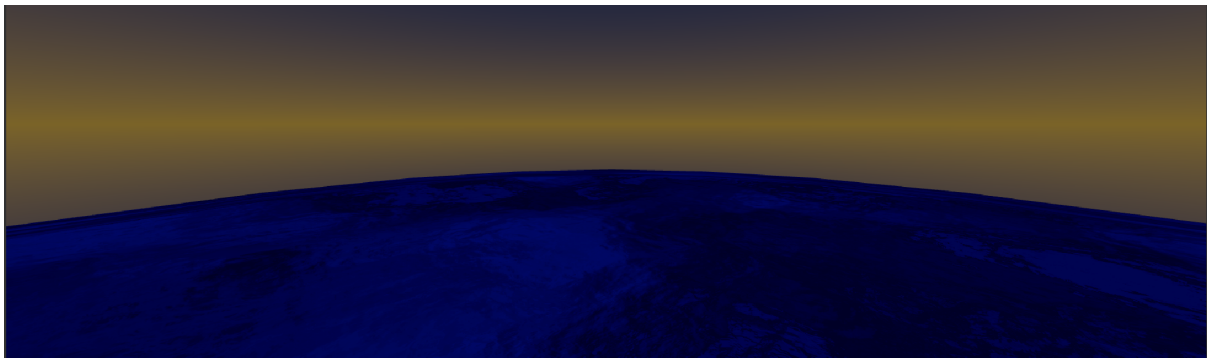


Figure 30: Soma VE (developed by Clarice Hilton, 2019)

In both *Figuring* and *Soma*, the bodies of participants are unseen in the first moments of their being in the VE. In *Soma*, the participants remain held within the loop of jelly string, very lightly connecting them as they open their eyes and enter visually into the VE. It is not until after they have entered and engaged in the VE that the loop, which is then backgrounded in the experience (as it is part of the non-visual, physical environment), is removed by the dancers. These early moments with the participants' bodies not yet visual in the VE in *Figuring* and *Soma* draw from the experiences and issues that came up for the *WOS* participants concerning their unseen bodies in the VE and from Popat's recollection of the activation of a proprioceptive and kinaesthetic sensing response in her body order to visually navigate a VE in which her body was absent.

Figure 31: dancer and participant in Soma (2019)

In *Soma*, the participants are momentarily invited by the dancers to look around, to move and to explore the VE as unseen bodies in that environment. On entering a VE, there is a moment whereby the visual environment absorbs the attention of a participant and, unseen in that environment, the body can become absent or lost. In *Soma*, this moment occurs, after which there is a returning to the body, an attentional shift back to the physical environment, initiated by the dancers – through words and touch. Without this loss of the body, there cannot be a re-finding, a re-activation of the body – with no visual cues, "they tether you to an embodiment that perhaps is about the material, physical, architectural world and therefore disembody you from the virtual world and for me, some of the most engaging moments were where I actually forgot about that …it's strange because you slip in and out" (Participant 2018-19: 50). Slater writes about the ways in which VR technology "offers a challenge to the everyday relationship between mind and body" (Slater and Usoh 1994: 4). This relationship, between mind and body, between visual and felt sensing, can be investigated and challenged, as it resonates through this process of losing and re-finding the body across physical and virtual environments. "[T]he mind might be fooled [temporarily] into the illusion of being in an alternative world – the results of head tracking strongly confirm this, since a turn of the head to the right swings the world to the left as in everyday reality. Motion parallax and stereopsis provide further evidence" (Slater and Usoh 1994: 4). As the participant looks to find the body in the VE, it is missing, yet the proprioceptive stream continues to inform that that the body is still present and moving.

Figure 32: dancer and participant in Soma (2019)

The *Figuring* and *Soma* participants responded in different ways to the moments in which their bodies become visibly represented in the VE. This often depended on whether or not they had experienced VR before. The novice participants were "very preoccupied with just

looking at themselves" (Participant 2018-19: 62), tending not to approach anyone in the VE, keeping mostly to themselves. "As soon as we were in that other world, I could see where other people were, but it was so overwhelming that I felt driven to kind of explore what it meant to be in that space just at all, let alone with other people" (Participant 2018-19: 12). In contrast, the more seasoned VR-goers seemed to be much less concerned with their own sense of presence and visuality in the VE and more curious to engage with the multi-person functionality of the system, exploring the kinds of interactions they could do with others. "I felt like the others were looking at their own bodies in that world and they were very preoccupied with themselves rather than others in that world. Which is kind of funny because it's multi-user" (Participant 2018-19: 62).

Figure 33: dancer and participant in Soma (2019)

On inhabiting a virtual body within a VE, "[w]e recognise our own habituation there, through our body becoming an object in that environment" (Slater and Usoh 1994) and "recognise the habituation of others through the representation of their own bodies" (Slater and Usoh 1994: 18). The temporary sense of body ownership of an avatar or virtual body in the VE is widely evidenced due to the highly influential and malleable "body schema" (Clark 2007). Biocca goes one step further to consider the virtual avatar of a participant in a VE, more than bodily or self-representation, as a substantive transference of "an internal subjective representation of the self, that is a model of the self's body and a model of one's identity" (Biocca 1997). My research challenges binary modes of thinking on the body as either virtual or digital, using practices that open up an attentional movement between these realms. Centring the

body fully with all of the senses in an experience of VR, rather than imposing an experience on the body from a top-down brain-to-body communication. My work with VR questions whether participants can bring their bodies and senses with them more fully to a VR experience, and what this means for different bodies.

The question, "[w]hat does it mean to inhabit a body?" (Koteen and Stark Smith 2008: 49) was responded to by dancer, and one of the originators of the dance form of Contact Improvisation, Nancy Stark Smith; "[f]or me, inhabiting my body is about feeling the actual sensations of my exact body in this exact moment – for example, expansion and release of chest with breathing, crick in the left trapezius muscle. It's about being present throughout your body as it is, not just having one to carry you around" (Koteen and Stark Smith 2008: 49). She continues by identifying what makes her present within her body, "I focus my attention on my physical sensations – feel my weight in the chair, the stretch of a particular muscle, the action in my joints, the touch of the floor, clothes, movement. I synchronize body (sensation) and mind (attention)" (Koteen and Stark Smith 2008: 50). Stark Smith's somatic sensing of her body is not situated around its visuality, but on felt sensations – of the flow, dynamic and weight of and within her body, its touching and tactile relations – to the air, the chair, the floor, clothes, etc. informing of its relational presence in the surrounding space. These modes of attentional awareness, of the body and the surrounding environment, are brought into play in *Figuring* and *Soma*. The participants and dancers form dialogues, through movement, touch and words, between the visual VE and felt qualities of sensing and presence such as those described by Stark Smith.

Inhabiting a body in a VE is reliant on its/a visuality in there, and this visual virtual body can inform the other, non-visual, senses to feel the presence of that body within the VE. The virtual body draws the participant's sensory attention further into the visual realm and reduces the contradictions between sensory data and proprioception (visual information and the movement of the body in relation to that visual information – through the movement of an avatar or such). These contradictions are considered by Myron Krueger, cited by Hansen, to get in the way of the "ultimate experience" (Hansen 2006: 26) of VR. Discrepancies in sensory information are issues that are "distancing participants from the worlds they were supposed to feel immersed in" (Hansen 2006: 26), a world which "should be indistinguishable from real experience" (Hansen 2006: 26), and entering into which should be a fluid interchange from one mode of reality or environment to another. For Stark Smith,

inhabiting her body relies on somatic listening in to interior sensations, to her breathing, to the connection she has to the ground. Her attentions are with and within her body in motion and in felt relations to her surrounding physical environment. Within a VE, this attentional sensibility of Stark Smith would create an ongoing discrepancy, a continual sensation of the perception gap. The bodies in this research are invited to sense and move in both physical and virtual environments and move across them, not existing wholly in one or the other. These bodies explore themselves as visual virtual bodies and physical felt bodies; these physical–virtual bodies can map and combine together as one body or mismatch and collide, offering fragmented sensations of the body. In this research, the body comes with the participant in their experience of VR technology; it is not left behind or reduced to a simulated visual entity. The body is attended to as a consistent factor in the experience of simultaneously being co-located across physical and virtual realities. Massumi argues that it is both reductive and deterministic to assume that bodies become digital by participating in technology, that "bodies are not digital, bodies do not communicate digitally, and that any digital aspect of a body works only to facilitate a continuous analogue relationship" (Buckley 2011: 13).

The body is changed in its relations with technology – in sensations of a located-ness within a VE, and through the ways in which the body is visually represented in the VE – the visual aesthetic and form of a visual body or avatar. The string-play in the first phase of *Figuring* and *Soma* set up a relationship between participating bodies and the environment grounded in analogue processes, engaging with the physical materiality of bodies, strings and spaces. These processes prepared the participants for an experience of VR, which opened up an exploratory relationship between the different aspects of materiality across the physical and virtual environments sensed by the body.

Dust (2016), developed by creative coder Mária Júdová, who is interested in "exploring what performance art and virtual reality can offer to each other" (Júdová and Boleslavsky 2016), is a 360-degree VR environment which "aims to transform the way people see and experience contemporary dance" (Júdová and Boleslavsky 2016). Participants in *Dust* "place themselves in the immediate presence of the dancer" (Júdová and Boleslavsky 2016), which allows them "to experience the work from different perspectives and within the space where the dance is happening" (Júdová and Boleslavsky 2016). Despite having more agency to move and to actively view the dance from different perspectives, breaking down the fourth wall, the relationships between the digital performers and the participant-audience members draw on

conventional roles: the performers dance and the participants watch. A key element of *Figuring* and *Soma* is the activation of liveliness and agency in the participant, not just as an observer of the experience but as a co-creator with the performer, shaping the experience as it unfolds. The relationships between the dancers and the participants in *Figuring* and *Som*a are activated and supported using all the senses. *Figuring* and *Soma* creates an opportunity for the participants to open their awareness to the ways in which they are habitually engaged with their bodies, with other bodies and with the environment, and experience alternative modes for sensing. *Figuring* and *Soma* also exposes the ways in which technologies, such as VR, reinforce habitual visually led patterns of sensing and thus reduce and suppress the availability of attention toward the other senses or to a fuller sensory connection. The participants explore different sensory pathways through the accumulative phases of the journey, awakening and enlivening their senses and increasing a sensory flexing and agency.

Visual Virtual Bodies

The visual representations and virtual bodies of the VE in *Figuring* and *Soma* were designed taking into consideration three key factors: firstly, as a way in which the participants could acknowledge their and others' presence in the VE, and as a means to recognise and communicate visually in that environment with each another; secondly, as a visual mechanism to support participants collaborative interactions in the VE, i.e. with the virtual strings; and lastly, as a more abstract visual exploration of presence and embodiment. The first two factors were developed from the technology-based representations in the VEs that were used for the *WOS* and *TFS* workshops. These were developed as *box bodies* (see Figure 34) in *Figuring* and as *hand balls* (see Figure 35) in *Soma*. These techno-representations drew the participant's focus to the represented areas so as to support simple head and hand communicational gestures toward one another and the movement of controllers in their interactions of the virtual strings.

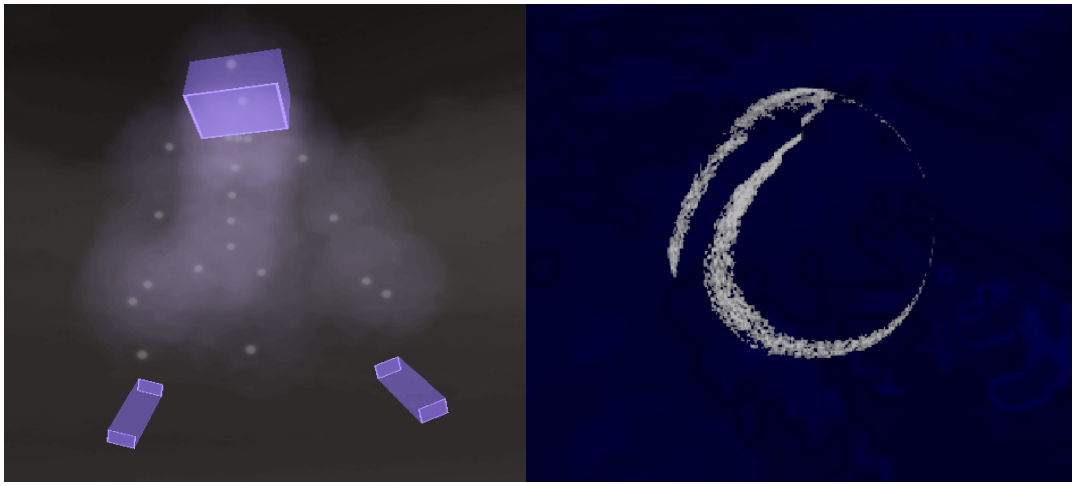


Figure 34: Box bodies in Figuring *Figure 35: Hand balls in Soma*

The shift from box bodies in *Figuring* to hand balls in *Soma* reduced the visuality of the body from three points/body parts to two. I was interested in finding the most minimal visual representation which could support the interaction in the VE that was required. This was based on *Figuring* participant feedback around the requirement for there to be some visual support with the string interactions, "if I'm holding a string and you're holding a string I wanted to see, visual acuity on that" (Participant 2018-19: 4). The hand balls were smaller than the box bodies in *Figuring* and designed for the participants to find their hands and to reach out, touch and move the virtual string using them as reference points, locating their own and the other participants' hands on the string. In *Figuring*, a visual representation of the body remained throughout most of the string interaction, something which I challenged in the VE journey design for *Soma.* In *Soma*, after a few minutes of interacting with the virtual string, the hand balls disappear. The intention behind this was to find out whether, once participants had understood and learned the system of interaction using the hand balls as visual aids, there could be a continued engagement with the virtual strings with their hands/bodies as unseen. This sensorial challenge required the participants to access and move their hands and bodies to interact with the string (and connect with one another through the string) without visual support, through "the dynamic spatial and relational disposition of our body and its parts" (Slater and Usoh 1994: 4). Accessing the body as unseen in the VE connected back to the central takeaway from the *WOS* participants, discussed in Chapter Two, and also to Popat's self-observations on her experiences with VR piece *White Island* – the activation of her proprioceptive senses with her body as unseen in the VE. Increasing proprioceptive sensation through taking away visual cues about the body connects with medical literature, evidencing that VR improves sensitivity to proprioception in stroke

patients more successfully without visual bodily cues (compared to using visual cues) (Cho *et al.* 2014). By not having a visual bodily representation, the *Soma* participants had to connect to their bodies, as unseen, in order to interact with each other through the movement of the string (rather than through the visuality of their bodies), connecting back to the ways in which they had moved and connected to one another in the physical string-play through the first phase of the journey.

The third factor in the development of the visual representations and virtual bodies of the VEs of *Figuring* and *Soma* was to explore more abstract visual explorations of presence and embodiment, which resulted in the *cloud bodies* for *Figuring* and the development of *Pauletta* for *Soma*. As briefly noted in Chapter Two, the systems of generating 'whole body' structures are based around the points in which the technology is located (the headset and the controllers) and use basic calculations to create the location/shape for the rest of the body. For instance, if point x is in one location, then point y is going to be in a relative location, e.g., from the hand to the shoulder, based on specific coordinates (often using machine learning to do this with more complex factors). Whilst this works well in terms of generating the basic structure of a body, the technology is not able to extend to coding the differences and complexities of bodies, their nuanced movement, flexibility and dexterity. The virtual bodies/avatars in *Figuring* and *Soma* were designed and developed not as realistic human body shapes but more as fluid forms, drawing on a previous research project, *Dances with Avatars* (Thomas 2016). Lanier constructed several experiments in which he pushed the spectrum of possibility for what the illusion of having a body in the VE might be. The "homuncular flexibility" (Lanier 2017: 140) he writes, is "the mapping of your body [in the VE] to your motor cortex" and can encompass a wide range of options – bodies ranging from lifelike avatars to distinctly un-anthropomorphic forms. From his experiments, he ascertains that "[t]he illusion can be pushed further than you might imagine" (Lanier 2017: 140). The *Proteus effect* (first introduced by researchers Yee and Bailenson at Stanford University in 2007) is a known phenomenon describing the mutable relationship between visuality and behaviour, the ways in which the behaviour of a participant in a VE is changed by the characteristics of their virtual body or avatar (Yee and Bailenson 2007).

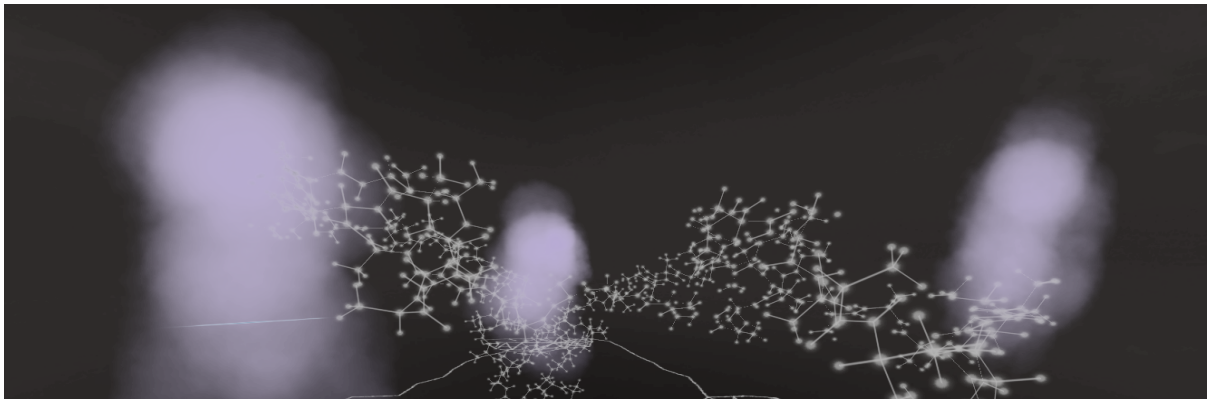


Figure 36: Cloud bodies in Figuring

The cloud bodies in *Figuring* explored a blurring of body boundaries and were an experiment in colour and latency; the cloud-like entities moved through different colour states and a latent effect that caused a moment of delay between the physical body and the cloud body. *Figuring* participants felt that the cloud bodies were confusing in their experience of the VE, due to the lack of acuity, they were "blurred images" (Participant 2018-19: 9), the latency effect causing difficulty in supporting the interactions between participants, "I'm here, I'm interacting, I know there's a person over there, I really want to communicate with them, I'm looking at them, and I'm kind of like 'hey, let's play' and they, maybe they don't know that, maybe they don't understand" (Participant 2018-19: 25). This confusion and subsequent loss of connection between the participants in the VR section of *Figuring* impacted the last phase of the journey, the loss of "physical connections between people in the last space, I kind of was back on my own again in a way" (Participant 2018-19: 37).

Figure 37: Pauletta

The final visual state in the VE for *Soma* was called Pauletta, designed in response to this lack of connection felt by participants in the *Figuring* VE. The state emerges from the location of the controllers, held in the participant's hands, and begins with small points of

light, which gradually form as lines creating web-like constellations. In contrast to all of the other visual interactions in the VE for both *Figuring* and *Soma,* the light points in Pauletta do not require any activation from the controllers and therefore allowed participants to attend directly to the relationship between the movement of their hands, arms and bodies and the visual constellations that were emerging around them. In the final moments of the VR phase of the journey in *Soma*, using Pauletta*,* participants started to both notice one another and also to gather a sense of their own visual presence in the VE, as fluid virtual bodily constellations of points and lines that were being created through movement. The dancers, who were moving and dialoguing with the participants through the VR section of *Soma*, encouraged the participants to play with this state across the perception gap of seeing and feeling, for example, drawing the contour lines of the participant's body or their own body with the controllers, and then taking the body away and exploring the gaps, the absence and presence of the body across visual and physical territories. The words of dance artist and scholar Carol Brown, who unpacks notions of "[p]erformance identities" (Brown 2006: 85), offer a sense of this elusive play between participants and dancers across physical and virtual terrains:

> [t]he privileged state of performance as a 'being here' in the elusive present is no longer embodied in the taken-for-granted 'thereness' of the stage of soil and flesh; it becomes a superabundance of becomings experienced as hyper-realities and distributed presence. In this context, the 'being in the body' of embodiment is radically reconfigured. (Brown 2006: 85)

Virtual Strings

Figuring and *Soma* are not VEs that orient around specific tasks or aims but are instead centred around a collective explorative play – of the VE and the materials within it. This is in a continuation of the physical string-play in the first phase of the journey, making loops and twists in the virtual string as they had done in the first physical space with the physical elastics. Using the string to sense one another and to collectively move it and within it, "there was a mimicry of what we had done before, and we were given the same sort of orders; there was a conditioning beforehand, as it were. I think if I hadn't done the previous experience in reality, then I don't think my mind would have been in that frame" (Participant 2018-19: 23).

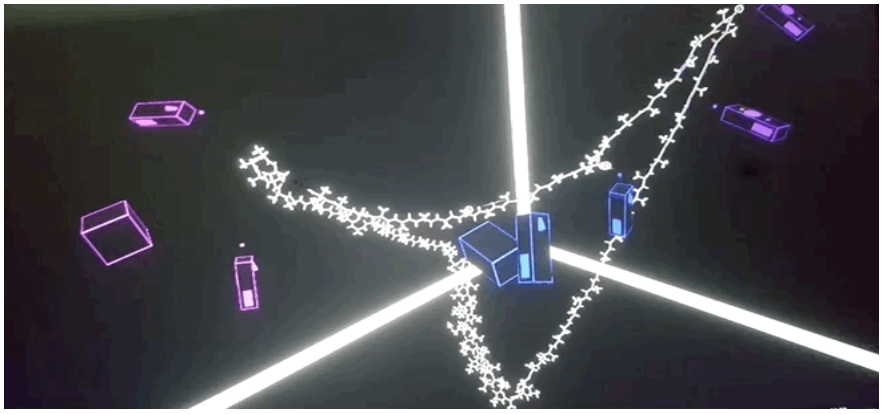


Figure 38: The virtual (molecular) string in Figuring (developed by the IRL, University of Bristol)

The virtual string was developed for *Soma,* with new technical collaborators, taking out the complexity of the molecular properties of the virtual string (O'Connor *et al.* 2019) and networking an open-source rope simulation (Obi 2019) so that multiple users could interact with it. The process of creating the right aesthetics for the rope involved intensive material and virtual explorations with the dancers moving through different virtual physics, for example, sliding scales of factors such as weight, gravity, and flow – terms that had little meaning with reference to the ways in which they would operate in the physical environment and had to be experienced and investigated in different groupings. In doing this, the main aim was to explore the ways in which the visuality and movement qualities of the string invited a sense of the earlier connectedness of the physical string-play and that the two different virtual strings played on affording different movement qualities and physicality in the participants in their interactions with it – as the thick Prym elastics and fine transparent jelly string had done previously.

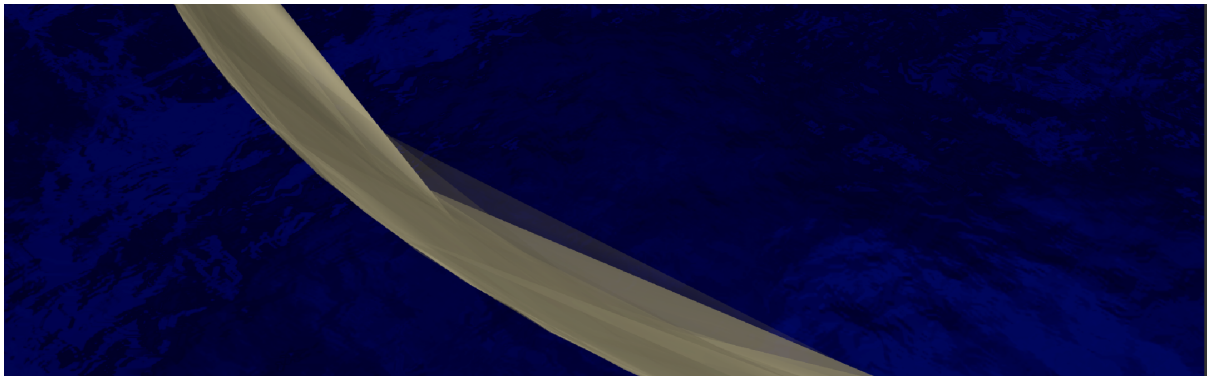


Figure 39: Fascia string in Soma

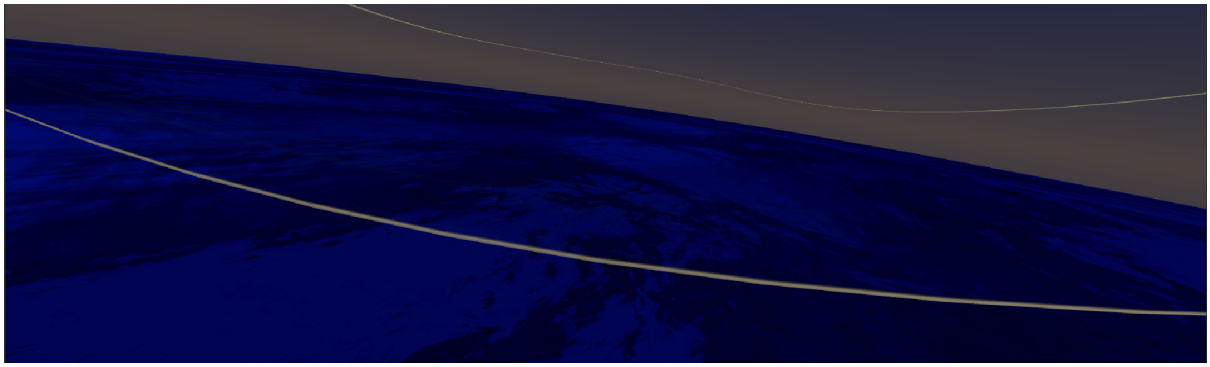


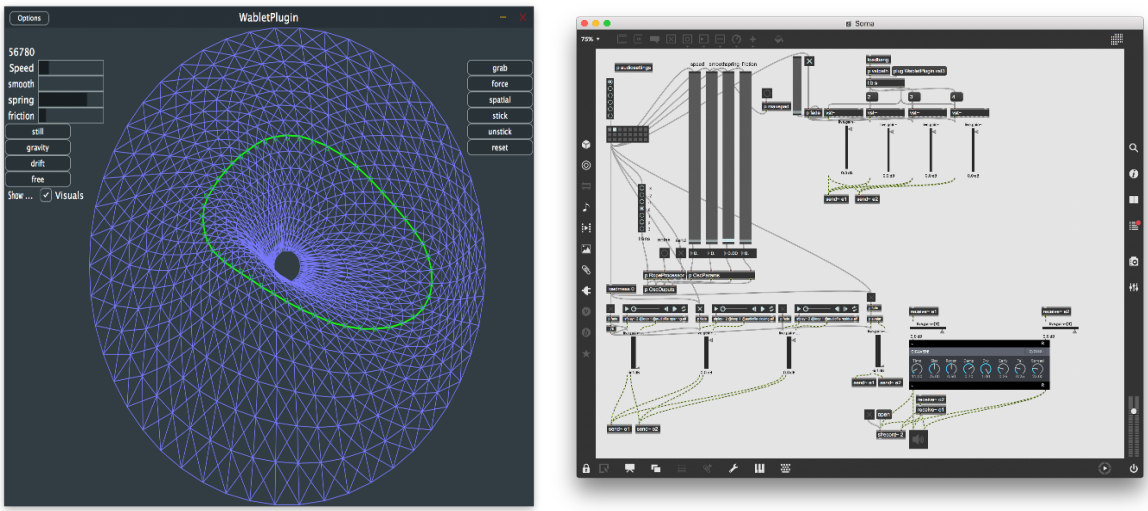
Figure 40: Jelly string in Soma

After the participant's initial exploration of the *Soma* environment as unseen bodies, the *fascia string* (see Figure 39), a golden, thick, elastic (with similarities to the first physical string in the physical environment), emerges from the horizon. On noticing this movement in the environment, there is a desire to reach toward it and to touch it. At this point, participants are invited to take their controllers, their hands, by the dancers. The hand balls emerge and then dissipate after a short period of time (as previously discussed), and a new string, a lighter string – akin to the jelly string – appears (see Figure 40). With the absence of any visual body/hand representation in their engagement with the lighter string, the main form of visual communication, the participants ascertaining their and others locations and movements, is through the movement of this string. This movement-centred mode of communication connects back to the physical string-play in the first phase of the journey, in which the bodies of participants and dancers connected and communicated through the play of the physical strings, offering a comparison between the digital and physical materialities of the strings (see *Soma* video at timecode 7:38-7:45).

Development of the Sonification of the Virtual Strings for *Soma*

Sound was a key factor in developing the ways in which the participants could interact with the virtual string in the VE. The molecular aspect of the VR framework used in *Figuring* brought a complexity to the relationship between the participant's movements in their interactions with the virtual string (as a simulated protein molecule) and the sounds produced by the system (as had been experienced by participants in *TFS* workshops). *Soma* was developed with new technical collaborators (see Appendix 1) with a different (non-molecular) VR framework, and this reduced the complexity of these participant interactions in the VE. Sounding the string in *Soma* became a more intuitive and playful experience and was developed as a key part of the participant journey in the VR section.

The sonification of the virtual string for the *Soma* VE was achieved by Dr Tom Mitchell, who used a *Wablet*, originally created by Robert Tubb (Tubb 2012). Mitchell took the code and modified it to work as a VST plugin (*Soma*Wablet), with a different audio/visual library so that it can be loaded into MaxMSP (*Soma*Max). He also modified the system so that it was controlled via the VR controllers rather than a touch interface (iPad), as it had been originally. Four instances of the Wablet plugin were used, one for each participant, and when they grab and move the *Soma* rope, they also grab and move a point on the mesh in the plugin. The participants' movements translated into a variation in the timbre of the sound, and the virtual strings became like instruments that were collectively played. The participants would pull the string from their different locations outwards, away from the centre of the space, and on a count of three would release the string, watching and hearing it ping' back into the centre-ground between them. Slater indicates that the role of "sound has a highly significant impact on presence" (Sanchez-Vives and Slater 2005) within a VE. Observing the participants activity on the outside of the VE, there was a tangible sense of the virtual string's presence in the space without seeing it. The string was sensed across both environments (physical and virtual), the sound acting as a bridge between them, connecting the bodies in each. Sound is a very useful and important tool, particularly for a multi-person VE, in bringing people together across the physical and virtual domains, exposing and offering information from one realm to the other. In my research, I explored how sound could be used to offer additional resources for participants in their experiencing of the perceptual gap between seeing and feeling and their virtual-corporeal crossings.



Figures 41 and 42: Wablet synthesiser (SomaWablet) and MaxMSP patch (SomaMax) that processes all the data from the Soma rope system and connects all the audio parts together

Michael Bull, in Jones' edited book *Sensorium* (2006), writes, "[t]he auditory – in the hierarchy of the senses in the Western world – ranks after sight" (Bull 2006: 112), though sound "manages to trouble the visually inspired epistemologies that we take for granted: the clear distinction between subject and object, inside and outside, self and world. Sound shows no respect for these divisions" (Bull 2006: 112). Sound and vision are synchronized in the brain, and this unconscious mixing of the senses can lead to modes of perception that favour vision. VR has the potential to separate out not only the relationship between sight and touch, which is investigated in this research, but also the relationship between sound and vision/the other senses. This splitting up of the senses, whilst superficial, can open an awareness to sensory traits and support synaesthetic processes in the senses which challenge these traits. The question that arose from my research with the sounded string in *Soma*, and which, in my opinion, warrants further study, is of how the relationship between the sound of the virtual string and the movement of the participants' interactions with it (via the controllers) might enable a participant's ability to sense or see (imaginatively) an interactive visual VE without seeing it. Accessing a VE without seeing it might subsequently lead to a different sense of and connection to the materiality of this environment, which may inform how the physical world is attended to (more synaesthetically). As Machon writes, "[t]he heightened sensual perception involved impacts on the type of intellectual sense that can be made when we are spectators to our own experience – when we attend to our actions, reactions and interpretations" (Machon 2016: 35).

This section, which outlines and discusses the second VR phase of the *Figuring* and *Soma* journey, has addressed the different creative, design and technical processes that took place in the development of the VEs and in the choreographies of the bodies inside and outside of those VEs. The key factor within these processes was focused on the ways in which the perception gap could be exposed, explored and shared through these designs, technologies and choreographies. The next section of this chapter follows the participants as they leave the VE and the VR technology and enter the final phase of the *Figuring* and *Soma* journeys.

Phase Three: (Post-VR)

The *Residue* Environment

In many VR experiences, taking off of the headset marks the endpoint of the experience, of participation. Most VR experiences do not factor in or consider, to any great depth, the

moment of exiting the VE and what occurs beyond this moment (other than collecting personal belongings and exiting the space). An abrupt outwardly plunge from the depths of a VE into a lit physical environment with other people around, perhaps some who have been watching is a common experience of VR. Knibbe *et al.* write, "[t]he act of entering and exiting VR – the very moment of donning or doffing the headset – plays an important role in the overall user experience" (Knibbe *et al.* 2018), in particular the immediate moment of exit from a VE – which is a little-understood moment of an overall VR experience. One commonality in the moment of exiting the VE is the "sudden realisation or collapse of the experience, when the participants realized they had been subject to an illusion" (Knibbe *et al.* 2018: 1). At this moment, there is an element of "surprise" (Slater *et al.*, 1998), and this, according to Knibbe *et al.*, is due to the "discrepancies between similar real- and virtual-environments" (Knibbe *et al.* 2018: 2). Slater writes about the links between this transition of exiting a VE and the level of presence experienced by participants when they are in the VE, making the case that having an increased sense of presence will lead to more (requirements for) adjustment on exiting.

In considering an exit strategy from the VE, Kibbes *et al.* explore themes of space, control, sociality, time and sensory adaptation, which they evidence across participant experiences of disorientation and reorientation on exiting the headset. The evidence brought together by these researchers point to certain factors in a VR experience which affect the participants' experiences of exiting the VE. These factors include the participant's level of trust in the VR experience as a whole, being able to move when they are in the VE and their sense of control over the removal of their own headset. The sense of being watched from the outside is also a key element in participant experiences of exiting a VE, as well as undergoing a sensory transition in readapting from the VE to the physical environment. The findings ascertain that, on exiting the VE, there is a transitionary period of time that occurs in which the participants are between being in the VE and being in the physical world. This implies that the crossing between the virtual and the physical environments is not instantaneous for participants. There is a momentary gap, "not returning to actual reality before visual and auditory senses were again available" (Knibbe *et al.* 2018: 2). This correlates with my own experience of exiting the VE and that of many of the participants involved in this research, for example, in the workshops. These experiences have fed into the design for the *Figuring* and *Soma* journeys, specifically in considering the practices employed by the dancers as participant guides and the (light, sound and material) information present within the physical environment in

developing the participant experience of the after-space of VR. Knibbe *et al.* suggest that this "transition period may present a potential for intervention, such as lengthening the transition period between the virtual and real environments to heighten tension" (Knibbe *et al.* 2018: 2). The after-space in *Figuring* and *Soma* is designed to offer an open framework for a potentiality of sensory and relational occurrences to take place. An environment in which the participants can continue to be enlivened sensorially, influenced by the virtuality of the VE. Machon draws on Deleuze (Deleuze 2001), in writing on the sense of "between-times, between-moments" (Machon 2016: 39) which come about "due to the felt, live(d) quality of every second of the direction of the piece. Artworks that harness this live(d)ness can actuate a lasting ephemerality – (it) lasts in the interactor's embodied memory of the event" (Machon 2016: 39). In *Figuring* and *Soma*, the participant journey is designed with considerable emphasis placed on the transitional moments between states of sensing and presence, the phases of the journey "a sort of series of thresholds that you cross" (Participant 2018-19: 18). This threshold between the VE and a return to the physical world being a crucial moment in the overall experience offers the participant a way of being opened to the senses shifting back to normal, and, within this, the opportunity to not return for a while longer.

In the journey design for *Figuring* and *Soma,* there is allocated time for transitioning, both prior to putting on the VR headset and after its removal. Even though the physical environment is attended to within and as part of the experience of the VE, the participants do not see the visuality of the physical environment in which they experience the VE, in which the technology is housed. This is because they enter into the space from the walk with their eyes closed. The physical space is experienced non-visually, whilst the participants are embedded in the visual domain of the VE. Through this VR section of their journey, the participants build up a sense of the physical environment, mapped through the sound of the space and the movements of the dancers, the feel and temperature of the air, and the texture of the ground underfoot. For some participants, the sense of the physical space and the human and non-human entities within it (unseen) was more emphasised or tuned in to than for others.

Before taking their headsets off, the participants are invited to close their eyes and to keep their eyes closed for a little while as the headsets are removed (supported by the dancers). In these moments of transition in *Figuring*, the dancers invite a somatic-attentional shift back to the body and toward the weight of the VR headset on the head, sensing the physical

materiality of the technology, their breath, and the touch of their feet on the ground (see *Figuring* video at timecode 9:21-9:22). The relationship between the dancers and the participants, in these moments, continues as unseen. Their felt presence and the verbal and touch-based invitations given by the dancers are part of a consistent and continuous aspect of the whole participatory experience of the piece. The participants open their eyes to a darkened environment to support the process of visual adjustment (as is outlined by Kibbes *et al.*). Drawing from the ways in which *TFS* participant's imaginations were highly influenced by the VE after they had exited the headset, this darkness also opens up the possibility for a continued sense of the visuality of the VE to reside in the visual imagination, in the 'mind's eye' and beyond the use of the technology. From this point, the participants enter the residue environment, which is conceived as an "imaginal environment" (Biocca 1997), neither physical nor virtual, as the final phase of the performative journey.

Figure 43: Figuring team in the material space designed by Philippa Thomas

Whilst the concept for the space remained largely the same, the design of the residue environment completely shifted between *Figuring* and *Soma*. The residue environment for *Figuring* was based on the participant experiences in *TFS* workshops, specifically the ways in which the VE influenced and expanded the realms of their imaginations. *Figuring* used the residue environment as a space-time that operated around the realm of the "potential" rather than that of the "possible" (Chvasta 2005). I developed a score, *Re-worlding*, which took place with the whole team of *Figuring* collaborators as a physical practice and exploration into what this environment might look, feel, sound, and move like, what it might house physically and materially, and what activity or movement might occur within its bounds (see Figure 43). The score was influenced and inspired by the words of Donna Haraway on the potentiality of her notion of mattering: "It matters what thoughts think thoughts. It matters

what knowledges know knowledges. It matters what relations relate relations. It matters what worlds world worlds. It matters what stories tell stories" (Haraway 2016: 35).

The *residue* environment was conceived as a space freed from normative modes and conventions, in which the participants might find and explore the shifting perceptions and modes of embodiment and movement that had occurred through the journey they had just undertaken, and to find ways to share these experiences and to be together in this liminal space. Similar to the instances in which people stay in their seats after watching a performance or film in the theatre or cinema before heading into the social space of the bar, foyer, etc., the residue was a place to rest and reflect on the experience before entering back into the everyday world. The final design for the residue environment for *Figuring* (created by set and materials designer Philippa Thomas) brought into play different physical and virtual layers of the journey that had been undertaken by the participants, with elements of sound that drew from different aspects of the journey (designed by Jo Hyde). There were places to rest and contemplate the experience, different materials to touch and move with, and projected video-work of the dancers performing string-based choreographies as a reminder of the previous string-play (see *Figuring* video at timecode 10:47-10:50).

Figure 44: Figuring residue environment designed by artist Philippa Thomas (September 2019)

Participants enjoyed the residue environment as "a buffer, a kind of transitional space in which I eased out of playful improvisation and material and embodied ways of engaging with people and objects into conversation and reflection and the social" (Participant 2018-19: 50). There was a freedom within the space, "just being able to walk around physically and touch things, the feel of things" (Participant 2018-19: 43). The participants enjoyed the way it created a "kind of decompression zone to get back to some more tactile realities" (Participant

2018-19: 46); after the virtual materials of the VE, the tactility of the space was "a nice juxtaposition to not really being able to feel stuff in VR" (Participant 2018-19: 43) (see *Figuring* video at timecode 10:55-10:58).

There were two significant areas of participant feedback for *Figuring,* which were specifically related to the residue environment. These outcomes led to a complete reimagining and redevelopment of this phase of the journey and of this environment for *Soma*. The two aspects that came up in the one-to-one conversations with the *Figuring* participants were, firstly, around the role and presence of the dancers in this final environment and, secondly, the visual emphasis in the design of the space. The *Soma* residue was created in response to this feedback and through a creative process with new project collaborators and testing with focus groups – specifically with visually impaired participants.

The *Soma* Residue

In *Figuring*, the dancers caretake the participant journey up until the moment of entry into the residue environment, "you had the dancers who had been there with you from the beginning, and so they were factored in, and they were your safe guides" (Participant 2018-19: 6). On entering into the residue environment, the dancers shift in their roles, becoming less as guides and more as physical presences in and of the space. "I felt like I was kind of alone and separate – I was experiencing it as just me and a sense of a longer-distance connection" (Participant 2018-19: 21). As a result of this shift, the participants became more aware of needing to caretake their own time, "I wasn't worrying about time and when it was, like, stay as long as you like, then my brain started going" (Participant 2018-19: 35), "to be let go and suddenly have to make your own decisions again" (Participant 2018-19: 18). There was a sense that the participants no longer felt the relationship with the dancers in the way they had been previously in the journey, "even in the VR, there was someone next to you, and there was a real sense for me that I could sense they were there. I guess actually in that final space I didn't have that sense anymore, the dancers kind of separated from us" (Participant 2018-19: 18). There was even a sense of loss for some, "bereft is probably a too stronger word, but there is definitely a sense of parting, of having to be on your own again. A sort of re-entry. If you view the piece as a sort of series of thresholds that you cross, it was definitely a significant threshold on the kind of landing trajectory" (Participant 2018-19: 18). The separation from the dancers initiated in the participants a process of "waking from the state"

(Participant 2018-19: 37) and coming back into reality. This was a premature waking, as the aims had been for the participants to be able to continue to experience their shifting perceptual state beyond the VE and into the residue. With the sense of loss of the dancer relations, the participants felt that they had to re-assume a normative stance, not able to rest back into a sense of time and decision-making which had been previously held by the dancers, "you're the one that has to make a decision to leave. Nobody else is going to take care of for you, so it does then bring you back in some way. The normal world" (Participant 2018-19: 37).

In response to this feedback, the decision was made in *Soma* for the dancers to remain with the participants, in their roles as guides and witnesses, right up to the end of the journey, including the final residue environment. This was supported in the words of *Anchor Score*, delivered to participants prior to them entering into the VE. The score opens up the possibility for a shared onward journey beyond the VR technology, with the dancers remaining an integral part of this. Reflecting on the residue environment as part of the *Soma* performances at Kaleider studios (March 2020, performed by Ben McEwan, Ania Varez, Anne-Gaëlle Thiriot, and Will Dickie), dancer Ania Varez commented on how she remembers the shared reflection of this final space, "I remember laying down with people like we all knew each other very well and allowing sensations to float above me like clouds" (Varez 2020). Dancer Anne-Gaëlle Thirot also reflected on how "we may want or find our residual space to be" (Thiriot 2020), that it could be and was (in the *Soma* performances) found collectively and differently each time. McEwan writes of this space becoming a "passage more independent from our actions" (McEwan 2020), as, through a "feeling of a change of flow"(McEwan 2020) and a slowing of time, a "more layered, reflective, reliving, grounded, self-sufficient solid state" (McEwan 2020).

The second important development in the reimagining of the residue environment for *Soma* was to guide it away from its previous visual emphasis, as it had been designed in *Figuring*. The visuality of the *Figuring* residue environment had caused participants to lose a sense of the felt connection that had been built up so surely through the journey, "it's like uncovering everything, you can see everything, and you could see the others, and you can see the other people's reactions" (Participant 2018-19: 66).

> When I saw faces, that was a problem for me because I reimposed some of my identity dialogues back on to whether I liked them when I met them, whether they were friendly to me when I first started to try and strike up a conversation with them earlier. I reimpose a lot of that identity politics straight back onto that space. It seemed to sort of, in some ways, close things down a little bit (Participant 2018-19: 49).

The shifts in perception, away from a visual dominance that had been made by the participants through the somatic and technological invitations prior to entering this final space, became taken over once again, consumed by all of the visual information in the space of the *Figuring* residue environment. Seeing one another and the physical space once again, after being so long without this visual information, made participants "more self-conscious" (Participant 2018-19: 37) and therefore "less playful in that space" (Participant 2018-19: 49), compared to how they had been in the previous phases of the journey. There was a sense of separation that seeing brings, "I felt less free because I can see everyone's boundaries now" (Participant 2018-19: 41), and this made the participants felt less connected. The earlier movement-centred play of meshworks of bodies and strings across physical and virtual terrains had been lost, as participants were "suddenly a bit removed from each other because we could see each other" (Participant 2018-19: 41). The strings and the technologies had mediated their relations and opened their senses.

The design of the residue environment for *Figuring* was "a lot to visually take in" (Participant 2018-19: 11) and created the sensation of being "like I was in an art gallery because it was like an installation" (Participant 2018-19: 34) (see *Figuring* video at timecode 10:15-10:23). This sense of the space brought with it specific conventions for participation, which were different to those which had been invited through the previous parts of the journey, "I remember going in and thinking 'oh this is like a gallery space now' and I don't know, 'am I meant to be walking around as if I'm looking at some gallery?' So, it felt like a real shift and raised quite a lot of questions about how I am meant to be now in this space" (Participant 2018-19: 10). "I sort of reverted to me on my own at a gallery in a way, so actually in that final space, I wasn't so interactive with the other people. I was kind of interactive with the space" (Participant 2018-19: 34). One participant commented that the residue environment felt like "a scenography that was someone else's creative imagination perhaps, rather than mine" (Participant 2018-19: 49), a comment which hugely contradicted

with some of the original ideas for the environment – as a space which would not impose on but would enable participants to activate their own imaginations.

Depth Perception

Another key factor in the reimagining and redevelopment of the residue environment for *Soma* was the feedback received from one specific participant – visually impaired (VI) dancer Holly Thomas. For Holly, *Figuring* was her first experience of VR technology. Holly is unable to perceive any depth – three-dimensional detail – in her usual sighted experience of the physical, everyday world around her. Objects and spaces are flat and blurred, with no defined edges. Stepping into the VR environment, Holly commented on how struck she was by the visual clarity of the VE and the virtual bodies and strings within it, seeing it as a three-dimensional world, "to actually to be able to visually see this kind of movement and this depth" (Participant 2018-19: 9). Unlike the human and non-human bodies and environments of her everyday, she reflected, "I have never seen anything in that amount of depth" (Participant 2018-19: 9). Due to the reduced visual noise in the VE, compared to that of the physical environment, it has been hypothesised (by vision scientist professor Ute Leonards at the University of Bristol) that Holly can access or activate more depth cues in the simulated environment. These depth cues are suppressed in her usual vision, in seeing the world around her. The shift in her visual perception, from the blurred, flat two-dimensional everyday world to the three-dimensional depth of the VE, was, for Holly, not just something located in her eyes. Her experience connected her increased, richer visual awareness to a whole-body physical sensation, "it really opened up these possibilities in my body to move in different ways" (Participant 2018-19: 9). In further research for *Soma*, Holly and I explored this desire she found in the VE to move and to reach out and connect with the environment, "I feel more comfortable exploring reach in a space in VR than I do in a real space" (Participant 2019b: 12). It is "a bit like being in a swimming pool when you go swimming, and you have that sense of freedom, the whole depth and width space" (Participant 2019b: 12). This has led to the production of a short film (Thomas 2019b) with the potential for further research.

Holly's embodied response to the visuality of the VE, the sense of moving in a three-dimensional environment, gave her the sensation and profound realisation of her own body as also being three-dimensional. "I really enjoyed being in this thing of a felt experience, you know, when you get a felt experience in your body from something visually" (Participant

2019b: 12). The senses are continually compensating for one another in synaesthetic processes, mixing the sensory data received by the body to make sense of the world. These processes are typically habituated in visually dominant patterns. David Abram calls for the need for a recuperation of the senses and calls for ways to re-enliven the senses in their active participation in perception to restore the synaesthetic potential of the sensory system (Abram 1997). For Holly, seeing is already embodied and synaesthetic due to her sensory capacity to navigate a space with reduced vision and the attentional awareness of her body in its relation with other, both through her awareness as a VI person and through her established practice and training in dance, specifically in somatic and contact improvisation practices.

Holly's experience of exiting the VE in *Figuring* was highly influential in the ways in which the residue was reconsidered for *Soma*. On exiting the VE and on entering the *Figuring* residue environment, Holly commented that the world had "become flat again" and that the *residue* environment "was a lot to visually take in and work out what it was and where things were and what was happening in there" (Participant 2018-19: 11). In the VE, "it was so easy because …you knew where everything was, for me anyway, really quickly" (Participant 2018-19: 11). Entering back into the physical realm of the residue environment, the perceptual shift, the sense of depth that Holly had experienced in the VE, had been lost. Responding to the issues raised by participants, and by Holly, around the unhelpful visuality of the residue in *Figuring*, the reimagining of the residue for *Soma* focused on creating an environment that would enable a sense of the continuation of the VE and, for Holly, a continued sense of depth and three-dimensionality beyond the use of the VR technology. The residue for *Soma* was completely redesigned, centring on the minimal use of light and sound to create an open and responsive sensorial experience – in contrast to the dominance of visuality and materiality in the *Figuring* residue.

On exiting the headset and the *Soma* VE, a very light thread is placed into the hands of the participants by the dancers – it is barely felt, an 'imaginal' thread (see Figure 45) (see *Soma* video at timecode 8:10-8:32). The participants open their eyes into darkness, remaining together with the dancers and with each other as they have been across the whole journey. A very gradual fade-up (over approximately seven minutes) of golden-coloured light occurs from overhead, diffused through a projection screen hung horizontally and suspended in a metal frame (see Figure 46) (see *Soma* video at timecode 9:25-9:53). As the light emerges, the threads between the participants become very lightly visible and, during this time, the

dancers make invitations to reflect, to remember, and to imagine. The lighting set-up was designed (by Jay Kerry) based on the idea of a sunrise, a gradual re-tuning of light from a place of darkness, bringing a gradual returning of sight. This use of light enabled there to be a period of time in which the participants could continue to be present in the transition from the VE and to have perceptual space in which to explore their senses synaesthetically, without needing to return straightaway to a visually dominant mode of engagement, control and decision-making. Artist Olafur Eliasson writes, "[w]hen surroundings are thought of as stable, we tend to lose a feeling of responsibility for the environments in which we move. Space becomes a background for interaction rather than a co-producer of interaction" (Eliasson 2007: 19).

Eliasson's work *In Real Life* (at the Tate Modern in 2019) emphasised: "the sensorial, moving from the purely visual to embodied experience" (Curtis 2019: 2) invoking, as Francesca Curtis writes, "Massumi's affect theory, in which he defines affect as an 'intensity' (*Autonomy of Affect* 1985) that takes place at the intersection between relating components" (Curtis 2019: 2). Curtis invokes, in writing on his experience of *In Real Life*, a similar sensibility or feeling of how I envisioned the residue environment for *Soma*. I wanted to create an environment that was always subtly, almost imperceptibly, shifting (in light), and the movement and sensing of the participants and dancers become part of this changing environment. Eliasson writes about artworks as not static, that they "exist in a manifold of unstable relationships which are depending on both the context in which they are presented and the variety of responses by the visitors – or users" (Eliasson 2007: 19). *Figuring* participants commented on their experiences of connecting to others in the *Figuring* VE energetically, "I felt connected to their energy rather than to them" (Participant 2018-19: 53) with a "willingness to play" (Participant 2018-19: 54) and, subsequently, they talked about the loss of this in the *Figuring* residue. With reduced visibility in the subtly shifting semi-darkness of *Soma's* residue, the possibilities for participants to remain in an energetic and willing relational sensing and play opened (see *Soma* video at timecode 10:11-10:29). There becomes, as Curtis writes in regard to *In Real Life*, "the potential to realign how the participant perceives their relationship to the environment" (Curtis 2019: 2). In *Soma*, it is in the after-space of the technology - the residue environment – that the imaginations of participants can extend into the realm of the potential - influenced by, but beyond the use of, the VR technology.

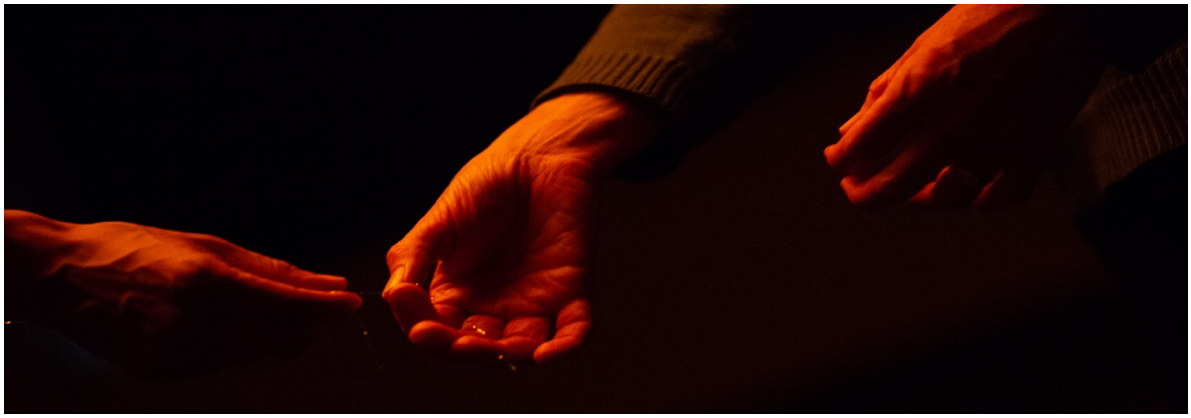


Figure 45: Light, silver thread introduced in the darkness of the Soma residue environment

Figure 46: Gradual light fade-up in the Soma residue environment

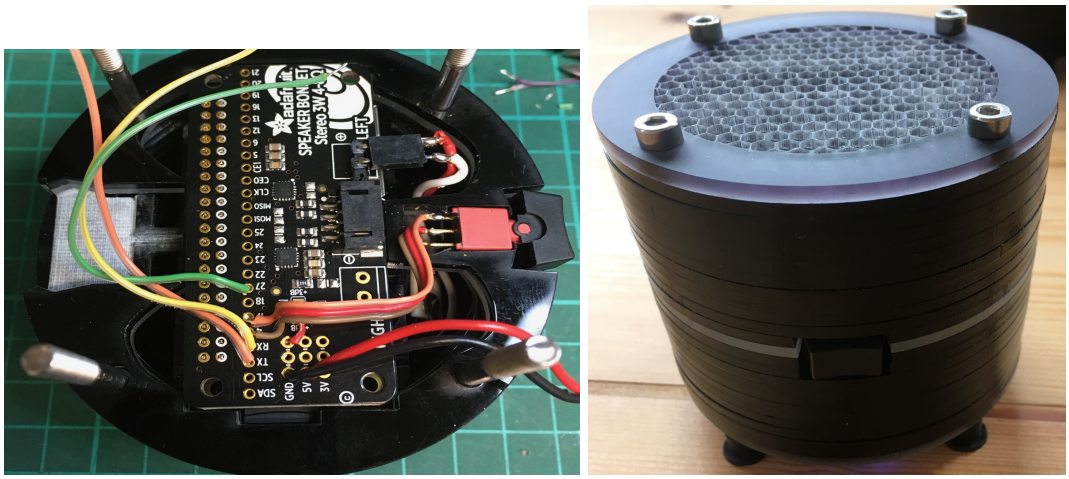
The use of sound was also a key element in the redesign of the residue environment in *Soma.* With Holly in mind, the question of how an environment could be supported by sound to offer or support a continuing sense of depth beyond the VE supported the investigations for the new residue. I took inspiration from a scene in the documentary film *Notes on Blindness* (2016), which is based on the audio diaries of John Hull. "After losing sight, John Hull knew that if he did not try to understand blindness, it would destroy him" (Middleton and Spinney 2016). In an early part of the film, on expressing his loss of sight, he talks about losing the world completely. Later in the film, he stands at an open door facing out towards his garden; it is raining. As he listens to the rain, he talks of how the sound of the rain *touches* every part of the garden, each surface and texture, and how this experience, in that moment, brings the world back to him.

> A note on the experience of hearing rain falling… this evening I came out of the front door of the house, and it was raining. I stood for a few minutes, lost in the beauty of it. Rain brings out the contours of what's around you. In that it introduces a blanket of differentiated and specialised sound. Which fills the whole of the audible

> environment? If only there could be something equivalent to rain inside. The whole of a room would take on shape and dimension. Instead of being isolated, cut-off, preoccupied internally, you are presented with a world. You are related to a world. You are addressed by a world. (Middleton and Spinney 2016)

This led me to think about the idea of creating a 'sound environment' for the residue in *Soma*, which shifts as it is moved within, with different sonic tones and textures present in different parts of the space – similar to the different tones and textures of rain hitting and defining the surfaces of Hull's garden. Six mobile, autonomous speaker units (which were designed and fabricated by Jo Hyde and Luke Woodbury), each containing and offering a different sound, were placed around the space. Each speaker played its sound independently of the others, resulting in the overall effect of an audible environment which was experienced differently in each part of the space and which, therefore, changed as the listener moved around the space. The participants and dancers in *Soma* were invited to move the little speaker units, and this meant that the sound shifted not only in relation to the movement of the bodies through the space but also through the way in which the speakers were moved and positioned. The concept for the speakers was also influenced by sound and light installation *Wave*, created by Squidsoup (2018). *Wave* is made up of a number of suspended orbs, which each offer light and sound. Each orb is "an autonomous and sensate unity consisting of LED lights, speaker and microcomputer, with movement sensor and wireless connectively" (Squidsoup 2018) and collectively, the orbs "create a resonant and dynamic audio-visual experience" (Squidsoup 2018). Having experienced this piece (Arnolfini 2018), the sense of being held by both the sound and light created by the orbs – not as individual units but as an overall effect – has stayed with me. Also, the way in which I experienced my own body and motion through the space, as intrinsic to the effects of the space on my body – giving me the sense of a relational interdependence between my body and the orbs, and the other bodies that were present in the space with me/us. I wanted to create, for the *Soma* residue, a similar effect of a distributed field of awareness and sense of interconnection between the bodies present using sound and very subtle light – so there was a reduced reliance on visual information in the space and sense of movement and the invitation to move within the space. The light, silvery threads were barely visible and barely felt, creating an echo of the earlier string-play – both in the physical domain and in the VE.

> For me, the ending was really strong [be]cause it was just this feeling of… back to this sense of connectivity… almost invisible thread that is connecting everybody and in this sort of heightened state of awareness and connection and this finer and finer thread, to the point where you can go away and it's invisible, but you still feel that connection. (Participant 2019a: 13)



Figures 47 and 48 Interior workings and exterior of the Soma speakers for the residue environment (Luke Woodbury and Jo Hyde)

Beyond the Residue and the Recall of Attention

The journey of *Figuring* had initiated different linkages, synaesthetic shifts in the participant's senses, and this experience of sensory recalibration stayed with many of them for some time after the performance event (I interviewed the participants between one and three months after the event). "That experience of being without vision and just thinking about how we privilege vision as a sense so much in our world, it's definitely made me think about trying to tune into other senses more, I think, since then" (Participant 2018-19: 47). Machon offers the notion of the synaesthetic quality of perception and cognition that is activated in immersive performance as something which can be "rekindled in any subsequent recall and analysis" (Machon 2013: 203). She writes that "[t]o experience synaesthetically means to perceive the details corporeally" (Machon 2013: 203), and it is through the "corporeal memory" (Machon 2013: 203) that the experience resides, as "something that embeds itself in part of your body and your physical memory" (Participant 2018-19: 7).

There is evidence to suggest that "behaviour while in the virtual environment can have a lasting psychological impact after subjects return to the physical world" (Madary and Metzinger 2016: 7). The long-term effects of VR have been a focal point of much research, for example, in its successful use for training applications – for adapting perceptual and embodied patterns (e.g. for military, space flight, surgery), and psychological issues such as phobias and fears (e.g. in a VR arachnophobia study, for example, 83% of participants achieved a clinically significant improvement of their phobic severity two weeks after their VR treatment). After Holly's experience of *Figuring*, follow-up research activity took place between the VR lab and the dance studio (University of Bristol) and during the *Soma* development process (Bristol Old Vic) (Thomas 2019b). In these subsequent sessions, Holly discovered that she was able to recall the way in which she was able to use her vision in the VE but outside of the technology. She experimented in moments of recalling the visual sensation that she had experienced in the VE and found that she could access, for short amounts of time, the same sensation of depth she experiences within the VE. This recall activity, for Holly, was an attentional practice not dissimilar to those used by dancers (including Holly and myself) to support particular sensory pathways which open up certain sensibilities toward their bodies, other bodies and the environment. Holly applied her dance-based approach and sensibilities in performing this attentional practice and, through this, found that she could access a temporary sensation of depth in the physical world around her and apply this to her embodied sense of being in that world. Holly's particular experience with VR and her ability to recall this experience without the technology points to the question of whether a VR experience, combined with an attentional practice specifically around opening sensory and somatic awareness, could support or be used to train a specific sensory pathway or a conscious organisation within the senses. This specific pathway or organisation could then be attentionally recalled without the technology.

Conclusion

In this chapter, I have discussed the essential components of *Figuring* and *Soma*, drawing on the creative and technical processes present in each work; the key themes that emerged through participant feedback and testing with focus groups, and critically framing these ideas and practices in relation to relevant scholarly thinking and other comparator artist's work. Learning from the key themes drawn from the *WOS* and *TFS* workshops enabled the development of the three-phase model for participation in VR in *Figuring* and *Soma*. This

model enabled a participatory journey which invited a re-tuning of the participant's sensory awareness toward the felt and sounded body and environment away from the visual before entering into the visual VE. The physical string-play in the first phase of the journey tools the participants in a movement-based mode of engagement, play and interaction and a felt sensation of connection, which is further emphasised in the eyes-closed walk. Within the VE, the relationship between dancers and participants occurs across physical and virtual realms, enabling the exposure and sharing of different experiences of the perceptual gap. Once the headset is taken off, the final residue environment invites a continuation of the sensory shifts that have been made by the participants, operating as a space for the activation of their imaginations in the absence of the technology. This process and journey highlighted the many different physical and perceptual tendencies of the participants and created space for these differences to be shared and experienced collectively.

Being in a (multi-person) VE, for some, can enable a sense of being "freed up" (Participant 2018-19: 49), a dropping of boundaries, of image and identity. It can be a "levelling experience in lots of ways" (Participant 2018-19: 52); it "stripped away any hierarchy" (Participant 2018-19: 52). In *Figuring* and *Soma*, participants are invited to enter into an intimate connection with their own bodies and with other bodies and the environment around them through somatic sensing and exchanges of movement, words and touch with the dancers. The "embodied sensorial sensations" (Participant 2018-19: 54) operated with and within the materiality of human and non-human bodies, through a sensing and mode of connection and collaboration which was "below identity" (Participant 2018-19: 54). This intimacy and the sensing of materiality were activated through both the enabling effects of the VR technology and the care of the dancers and their practices. Dance scholar Judith Hamera writes about the practices and tools of dancers embedded within 'dancing communities' and which offer possibilities for a "deepening of interpersonal exchanges" (Hamera 2007: 18). Dance practices are constituted in these intimate exchanges between bodies and environments, as templates for conventions for other ways of being, different to the everyday, common conventions of daily lives, and through which "real, desiring, emotional subjects come together across multiple dimensions of difference" (Hamera 2007: 18).

Through this research, and in developing *Figuring* and *Soma,* I have combined dance practice with VR technology as a methodology to enable shared and co-created perceptual journeys

between dancers and participants which explore the bounds of their collective attentional resources and imaginative capacity. The practices and sensibilities of the dancers provided a deepening of relations across physical and virtual bodies and environments in *Figuring* and *Soma*, "the craft with which that was handled was very absent elsewhere, and the understanding about those different modalities that your body will go through, and that you will even have a body at all when you're dealing with VR, is really, really misunderstood. So that's stayed with me" (Participant 2018-19: 2).

Soma and *Figuring* have explored the ramifications of a human engagement with VR by a process of examining how the senses encounter this technology and how this experience is processed, how it resides in the sensing body beyond the technology. In the introduction to this thesis, I laid out the central research questions, beginning with the key issue of the perception gap – an issue that was triggered by my own encounter with VR. This entire project has been predicated on this, my, VR encounter. It is anchored in the moment of tension and discomfort that I experienced at the start of this research endeavour. By bringing my dance-based awareness and practice to the design and delivery of VR participatory experiences *Figuring* and Soma, I have opened up a new understanding and experience of the technology. An experience that brings directly into an experiential focus the difficulty, confusion and possible shock, or even trauma, in the body, of the perception gap, rather than dismissing or occluding it. As soon as the VR headset is placed over the eyes, the realisation that this technology fully and immediately disturbs the senses is brought into an embodied practice and shared with others through this research. The practices underlying *Figuring* and *Soma* have activated, in the groups of participants and dancers involved in the projects, a shared somatic and felt presence which opened to a way of being together which confronted and was confronted by the technology. The realising of the effects of the technology on the senses in an experiential way with the different bodies of the participants opens up a wider realm of thought and concern in terms of how technology, more broadly, disturbs human perception and the ways in which people move, sense and act in the world. It is also important to say that this disruption often takes place unknowingly to them. My research brings into play a new way of encountering and engaging with VR and with technology more widely. This is a contribution that adds to the understanding of the capabilities of technologies like VR and to the conversations around their use and development. By combining VR with somatic work, the processes of my practice has exposed the ways in which perception itself is habituated differently in different bodies, and also the sensory

processes which underlie these perceptual traits and patterns and which also lead to certain modes of embodiment and embodied interaction. This implies that used in this way, VR can be a tool to find out more about human perception, not by further entrenching patterns of visual bias but by supporting adaptive and flexible capacities in the senses. This research opens up questions and concerns on the role technology plays in the world and its effects as an increasingly pervasive force in and on human life.

Returning to the Body

ZU-UK Artistic Director Persis-Jadé Maravala writes about her first VR experience:

> The roller coaster was going down. I don't like things like that. But I became completely obsessed with the thought that my brain would believe something even when I knew it wasn't true. I kept trying to meditate my physical reaction. All the physical sensations and reactions were already in play so I was trying to override my brain system by saying, 'It's VR. You're not really on a roller coaster'. I couldn't do it. My body felt like it was truly free falling. My stomach turned and my head started spinning. That was the fascination. The body will believe something and the conscious mind can't. Our involuntary systems are stronger. I found that little patch of inconsistency really interesting, the space. (Dunne and ZU-UK 2018: 216-217)

Interactive VR performance combining VR and binaural technologies *Good Night Sleep Tight* (Gerry's Kitchen 2017), created by Maravala and collaborators, uses this "little patch of inconsistency" (Dunne and ZU-UK 2018) in "constructing a false reality which is hard to override" (Dunne and ZU-UK 2018: 219). Using VR technologies with other sensory inputs which are aligned with the visual virtual information to trick the brain into believing in a reality that creates "physical urges or sides of themselves that they can't control or can't resist" (Dunne and ZU-UK 2018: 219). Maravala writes, "I'm interested in understanding what signals trick the audience's brain into deciding what is or isn't reality. It doesn't matter if you do or don't like it. The brain needs two or three stimuli to believe this is reality. You see your body, you feel the touch and hear the sounds…" (Dunne and ZU-UK 2018: 219)

Figuring and *Soma* do not operate in alliance with a technologically constructed reality; they bump up against it, priming and embedding attention in somatic and relational sensibilities, in bodies and environments which collide with the pull of a visual virtual world. The dualistic notion of "the solidity of real life on one side and the illusion of VR on the other" (Hayles 1999: 290) is shattered, as the body mediates both, extending, not limiting its capacity to sense, move and act within and across these territories. In *Figuring* and *Soma*, the participants move attentionally between the physicality and the virtuality of the experience, the 'availability' of these realms and the agency to act within them present within the work at all times. The sensory-somatic processes underlying the pieces open up the participant's

awareness of the technology as a shifting relational entity, from a physical material techno-object that is attached to the body to being unfelt as a mediator to a simulated environment. The attentional process of sensory tuning between physical and virtual bodies and environments, which accumulates through the journeys of *Figuring* and *Soma*, reveals and transforms habitual processes of perception. VR exposes perceptual habits, revealing well-used pathways between the brain and the visual system to drive movement and action in the world, and therefore human experience. Also, VR exposes the ways in which the body and its kinetic, felt sensations become secondary, 'after-effects' to the visual. In exposing these sensory habits and patterns, VR provides an opportunity to consider different ways to reattend to the senses, to the body, to other bodies and to the world around.

To conclude this thesis, I draw on the contributions and achievements of my research to point towards considerations and recommendations for future work, to the emerging theoretical and philosophical questions and the physical and experimental practices which will help to further investigate the significant issues that have arisen through this work. I draw on four key areas of contribution from this research to discuss these ideas and recommendations. Firstly, I open out the question of what constitutes a 'normal body' and how it is key to consider difference in processes of designing and using technology (for different bodies). Secondly, drawing on the design of the workshops and performances in this research - their sequenced, accumulative journeys - I consider how encounters with technology, such as VR, can be re-framed. The technology, as not the only or central constituent of an experience but placed within a wider context of activity. I also consider how this re-framing of technology could support a sense of embodied awareness and agency in human-techno relations, as well as offer further insights into perceptual patterning. Thirdly, I address the need for further intensive consideration of the ethical issues and concerns that have been raised in this research with regards to participation in VR, and in particular in shared and social VEs. Finally, I discuss the potential for new explorations of perception gaps using technology and sensory-somatic practices to uncover potential new territories for sensing.

Challenging Notions of a 'Normal Body' using Somatic Practices and VR Technology

The dance practices that I have brought to VR have guided participants through experiences of encountering the technology in ways that have enabled and revealed their 'differences'. These practices, activating and enlivening a somatic awareness and agency in the spaces of a

VE, enabled the participants to access and flex their sensory standpoint toward an interoceptive and embodied sensing alongside the visual grip on the senses that VR technology affords. The participants in the workshops and performances communicated and shared with one another their different expectations, experiences and desires in their encounters with VR. Discovered through the group and one-to-one discussions with the participants were the different ways in which they encountered the technology and the connection between these encounters and sensory processes through which the participants perceived and understood their bodies, each other and the environment around them. For example, the *WOS* participants discovered differences in sensory and imaginative processes in accessing their body as unseen in the VE. This learning enhanced their understanding of the processes inherent and otherwise undiscovered within their own practices in dance and somatic work. This participatory practice with VR has brought up differences in sensory, and thus perceptual and embodied, processes and subsequently, the question of what is considered to be a 'normal' body or a normative mode of sensing arises. Taking a nuanced approach through embodied practice to reconsider the moving, sensing, relational body in an engagement with VR technology brings possibilities for questioning and challenging broad and normative ideas and assumptions of the body and the senses. This process offers therapeutic or enabling effects in a re-engagement with the body and the senses.

The participants of this research, across each set of workshops and in the participatory performances, experienced an expanded realm of sensing, specifically around the seen and the felt, in moments of the perception gap. The invited co-presence of the seen and the felt within a VE, using somatic-dance tools, opened up this new sensory territory: ways of 'seeing' from and into the body, and modes of 'touching' that did not require a physical skin-to-skin or surface-to-surface contact emerged through the 'virtual' of the VE and led from the imagination. These experiences of sensing beyond normative bounds led to felt and relational connections with different aspects of the human and the non-human materiality at play. In particular, *Figuring* and *Soma* participant Holly Thomas experienced a physical sense of her three-dimensional embodiment drawn from the visual cues sensed in the VE, giving her a sense of depth, which is something not usually experienced by her in her everyday life. In one of the focus groups at Bristol Old Vic during the *Soma* development process (2019), another VI participant, 'L', found that the VE also shifted her usual visual experience. In the *Soma* VE, she experienced a strong sensation of touch on coming into (virtual) contact with the virtual string. Her experience was an embodied tactile sensation, the virtual string feeling

as though it was a silk scarf caressing her skin. “Both VI participants notice that they no longer see floaters or flashing light disturbance in VR. Both are aware of a heightening of the felt sense of touch but in very different ways. First, a felt sense of relationship to the environments. Second, physically [they] could feel the ribbon, its weight and textural properties, as a real ribbon [is] felt on the body” (Thomas 2019a). Holly commented on the way in which the three-phase model of the *Figuring* and *Soma* journeys supported these experiences and sensations, i.e. in the context of the practice and process of “arriving” prior to the VE and in exiting the VE, allowing “time for the adjustment” (Thomas 2019a).

The experience of Holly and ‘L’, as well as the other participants, is laid out with somatic-dance undertones, the processes of which supported their testimonies. The participants, led through a dance-based sensing process, mediated by my own understanding and sensibilities of the body and towards the sense of touch, supported their experiences and recalling of their own sensations. The participant testimonies take place and are narrated under specific setting, spatial, temporal, and material conditions. Conditions that allow for an opening between felt sensed experience and words. A linkage or bridge is formed between the movement and sensing and dialogic processes of recollection, an opening prompt to speak, and a reciprocal speaking as a recalling in the body takes place, an embodied practice within itself. In the co-production of this research, between myself, the dancers and other collaborators, and the participants, it is clearly not just the body-minds of the participants but also the framing of their experience that is incorporated within their testimonies. I frame their experience through the way in which I design it. It is not just their bodily knowledge that is at stake, but how their experience has been considered and set up. Permeating throughout the experience – from the wording of an email message to the guiding through the experience to the final goodbye – there is a sensibility toward the body, toward a felt sensing. This domain can be difficult to articulate into words, and much of this practice remains within the lived setting – within the bodies and in the spaces between bodies. The dialogue occurs as embodied movement and in the sensory space of breath and touch. Taking this work into a set of published outcomes will require the use of words, developing a language that resonates as movement, as breath, as felt sensing practices. Speaking and writing these as a series of forms of instruction, as a form of embodied practice in itself. A sense of breathing and speaking, touching and writing, as subtle and nuanced practices of care.

Underlying *Soma* is a practice that is not dominated by the immersive effects of VR as a simulated reality – a helpful affordance of VR which offers such things as the potential for pain relief or curing a phobia. The route of engagement with the technology that *Soma* invites is revealing of the different attentional propensities and sensory traits in the participants and invites these propensities and traits to flex. Working with Holly and then with participant 'L' has been informative in that bringing bodies/participants with non-normative or atypical sensory traits to an encounter with VR, using an approach that enables and supports them to shift synaesthetically, has brought up very interesting questions about perception and the ways in which it is embodied. As Merleau-Ponty found in his work, explored by dance scholar Brandon Calleja Shaw, "abnormal perception is the best instructor of normative perception; it is by learning how something does not work that we can discover how it works on its normal use" (Calleja Shaw 2020: 208). Shaw writes about how his [Merleau-Ponty's] "thought seeks out disruptions or breakdowns in both perception and daily ways of being that reveal the invisible and relish in the unconscious genius within habits" (Calleja Shaw 2020: 208). Something, some aspect of being, to not be working or operating normally, "forces a reflective experience of its normal use" (Calleja Shaw 2020: 208). I do not consider the endpoint of this research an attempt to 'get back to normal', but to reveal and live, enriched, with difference. By bringing a dance sensibility and approach to VR technology, I have opened up ways in which a participatory experience with VR technology can be accessible to difference, in contrast to a 'one size fits all' approach, which poses the risk of immediately closing off differences, and therefore agency, becoming exclusive only to those who 'fit'.

In processes of designing and using technology, it is crucial to not undermine or force unhelpful 'normative' traits for sensing and embodiment and instead to orient these processes around difference. The possible therapeutic or enabling effects for combining VR technology with dance and somatic work could support such a re-engagement with the body, challenging what is conceived (by many technology designers and technicians) as a 'normal body'. Using the practices outlined in this research, the future participatory bodies of *Soma*, and of VR more broadly, can bring to share not just their commonalities but also their differences and peculiarities. People all have bodies, and all bodies are different and particular. The spaces of VEs can give voice and agency to these different and nuanced modes of sensory and embodied awareness. "The notion that only through technologized immersion might we achieve true communion as we are freed from our bodies, our differences, our conceits, is an

ideology as pure and as old as monotheistic religion. Real community is made with bodies in proximity, different, divergent and heterogeneous" (Lopes Ramos 2020).

Before and After VR: Tuning, Residue and Recall

The three-phase model used in *Figuring* and *Soma* brought into play, in a VR experience, tuning and tooling practices as a precursor to entering the technology and the after-space of the residue, which offered a space of continuation and integration beyond the use of the technology. These pre- and post-VR opportunities provided an expansion of sensing and awareness of and as the material world and within the imaginations of the participants. The reframing of an encounter with the technology as not the only or key constituent is key to this approach. An approach useful to consider in reducing an (increasing) over-dependence on technology, offering many possibilities for taking the experiential learning and insight drawn from immersive technological encounters into physical, material, relational and imaginative worlds. The pre- and post-VR aspects of the participatory journeys of my research opened up possibilities for considering aspects of the technology that would otherwise be hidden and provided the space-time for an imaginative lingering in the sensory re-attunement that the technology affords, and a recalibration of the experience in the body and in relation with other bodies and the environment. Through this residue process also came opportunities for recall. A recall of sensory attention without the use of the technology, such as explored by Holly in her reconnection to her experience of depth in the VE, and how this resonated in her body as a physical, embodied sensation.

Performance-making practices activate and expand the imaginations of their audiences, and artists play in this realm of the imaginable, a world of potential happenings/situations, characters, bodies, movements and relationships, their work opening audiences toward new ways of feeling, sensing and thinking. "Synaesthetic imagination has the ability to induce changes in somatic processes and disrupt the boundary between the real and the imaginary" (Machon 2013: 204), and participation in performances such as *Soma* gives the participant new powers of imagining. The space of the residue invites a sidestep away from the usual way of doing, feeling, moving, relating. It is a queering or feminist manoeuvre for the imagination, an embodied unwrapping of the potential of things, a realisation of the many possibilities that are available in any one moment, a pivoting of futures. What might be the next questions for this residue? How might continuing stable humanity be imagined? What

ways of being, moving and togetherness, as difference, does this version of humanity constitute? What is a possible future in which different sorts of relations can be imagined?

The Ethical Issues of Interactive VR

My research is one of participation, "in which each participant's actions or behaviour are perceived and felt in real-time by another coparticipant" (Kester 2013: 28). As Kester explains, there is "the need for a more nuanced understanding of the complex issues raised by this work" (Kester 2013: 28), and this is the case for the work I have undertaken. These complex issues are around the ethics of the participation, issues which have arisen through the practice of this research. In response to practicing, in response to some of these emergent concerns, I have drawn from notions of care embedded within dance-based thinking and processes. My practice with VR has captured a more direct and heightened experience of how the technology forces and shocks the senses, rupturing a felt understanding of body and world. The capturing and heightening of the experience of the perception gap and the expanded sensory realm that exists through it is, in my opinion, an ethical response to the technology. A relation of care between the participants, the dancers and all of the collaborators involved in the projects, as part of the human and non-human world of the physical, the virtual and the imaginal, is considered and activated through encouraging a somatic awareness and agency toward these live bodies in action, and their lively, dynamic presence. The awakening of the senses is, in itself, an ethical stance in relation to the technology. A re-activating of awareness and an opening into choice, decision-making with regards to attentional resource in and as a body. The experience of this VR technological disturbance, its shock on the senses, is not attended to in other practices and research in any great depth; technologists (and artists) are, instead, encouraging their users further into the VE, without due care and consideration – no offer of flexibility and agency – toward the sensory pathways that are being over-activated by the visual dominance of the system, and thus those senses that are being suppressed.

When it comes to immersive technologies like VR, there are many complex ethical considerations in the forming of human-technological assemblages and subsequent lasting, long-term psychological and physiological effects. It is crucial that ethical issues and concerns should continue to form part of a critical debate around the technological design and use. Bringing a dance sensibility to the encounter between the human and the VR machine,

through a process of exploring and understanding the technology from my standpoint as a dancer and through my artistic practice, and in working alongside collaborators and participants in the development of a methodology, I have addressed issues that are not commonly addressed by technologists or by the VR industry. This process, originating from my own dancerly response to the technology, has raised key issues of bodily difference and inclusivity, sensory agency, and the lasting effects of VR. The critical conversations about VR technology, and other immersive technologies in terms of their design and use application, do not usually involve dancers. I have brought my perspective to the table, my way of experiencing the technology, which exposes, not covers over, the perception gap. Technologists have a limited view in terms of how to deal with the perception gap. My research offers a different perspective, which can add breadth and depth to the wider conversation concerning body-technology, human-machine, and analogue-digital relations.

With the rapid development of technology and also the confluence of different technologies, such as combining immersive technology, for example, VR with haptics or AI or deep fakes, increasing ethical questions and concerns will emerge, such as data protection, bias and transparency. For example, the (currently very popular) Oculus (Rift/Quest) VR headsets are now owned by Facebook, and in order to access a social VE using this Oculus technology, a Facebook sign-in is required, which comes with a sharing of personal data. With the development of ever more hyperreal image quality, the potential for psychological realism grows, and eye-tracker technologies that tally with speech and body/hand movements will move participants into ever more powerful routes of immersion and the generation of virtual experiences/memories. It is crucial to be speculating now, not waiting for these technologies to be fully realised with ethical participatory conventions not yet considered. HCI and its associated fields are considering the human in the interfaces that are being designed and developed, and the field of *Somaesthetics* has led to some more body-centred design work. However, a fuller sense of somatically sensing and moving bodies – their differences and sensory traits beyond the norm – is still very much absent from these processes and from the discussion. The capacity for being human takes place through the experience of having a body and accessing and understanding the world through the bodily senses. It is important to figure out where this fuller sense of the body is missing in the ethical debates about technology and how embodied knowledge from fields such as dance and somatics can contribute to these conversations and to ethical practices with technology.

Who is assuming the responsibility in the porous interactions between humans and machines? There is a shifting and transference of one into the other, an assembling and reassembling in form and in the distribution of agency. The ethical implications for bodies in social VEs are being considered in the work of Cortese and Zeller, though Loke and Schiphorst point out, along with my own view, that there is a need for a fuller realization by the designers of technology to create "technologies and interfaces that can take account of the somatic dimension, with its ethic of care" (Loke and Schiphorst 2018: 56). In immersive performance, there is a duty of care of the participant, and this is often constituted through the initiation of a performative contract. This contract, between artist and participant, performers and participants, Lopes Ramos argues, needs to offer an opportunity to invest "a deeper level of commitment and care" (Lopes Ramos 2020) for the participants themselves. Response-ability is a practice of mutuality, a practice of care that is shared between all, "each of *us* is constituted as responsible for the other" (Barad 2012: 215). All bodies at play come with a duty of care within performance scenarios, which should also be the case beyond the performative arena. *The Care Manifesto* by The Care Collective lays out the urgent need for a paradigmatic shift from "the current reign of carelessness" (Care Collective 2020: 6) toward a practice of care placed "at the very centre of life" (Care Collective 2020: 5). The Collective writes about the ways in which "we are failing to challenge the limits being placed upon our caring capacities, practices and imaginations" (Care Collective 2020: 5) and by "recognising and embracing our interdependencies" (Care Collective 2020: 5) it is possible to initiate change. This research offers practices of care which invite and foster a livelier understanding of human-techno relations and exchanges from within the human experience with technology and beyond it, a "post-human subjectivity" (Braidotti 2013: 51), in "the urgency of finding new and alternative modes of political and ethical agency for our technologically mediated world" (Braidotti 2013: 58).

Perceptual Gaps

I have brought to VR a practice that tunes a somatic awareness and gives sensory agency. This mode of embodiment directly challenges the typical use of the technology – in fulfilling its allocated purpose, which is to use the visual dominance in the sensory system to override the physical body and environment via a visual simulation. Investigating the resulting perception gap in my own body and in the bodies of participants in the workshops and performances of this research has exposed new insights. Typical or normative modes of

sensing – specifically of sight and touch – are revealed, and experiences that offer participants a new sensory terrain, expanded sensations rooted in modes of seeing and feeling across virtual and physical realities are created. By combining somatic sensing with immersive technology and taking this notion of a discrepancy or gap between the two sensory or perceptual inputs, radical insights can be drawn. It is interesting to consider what other perceptual gaps might be uncovered and what new questions and insights these might bring. For example, the exploration of sound in relation to sight and touch in a VR experience is an area in which little research has been undertaken and which may provide further insight on practical experimentation with the senses using this combination of sensing practices and technological immersion.

In 1966, Michel Foucault wrote of the blind spot between the eyes, a gap in which there is no visual information (Foucault 1966), confirming "yet, there is really only one opening – since what I see facing me is only one continuous landscape, without partition or gap" (Jones 2006: 1). From within an HMD, the visual information about the physical world has gone away or is backgrounded in the perceptual experience of the participant. The gap between the physical environment and the VE disappears and, as with the blind spot between the eyes, is hidden from the continuous flow of the perceived reality. This gap becomes exposed; it is available to conscious awareness by combining somatic sensing with VR tech. Jones of MIT writes, "[n]ow more than ever we need to think of the body" (Jones 2006: 1), to tool modes of awareness, and to make the human/body livelier in an aware and embodied living. To bring a consciousness and felt awareness, an empathetic, reciprocal exchange, to the embedded and embodied relations of the human, non-human and technological world, that is the meshwork.

In further consideration of perceptual gaps, questions arise, such as: What is problematic about perception gaps, and how might they manifest in life? What kind of power/empowerment structures are in play in overriding these perception gaps? How do escapism and collective experience rub against or support one another? And, how does a collective experience of a perception gap differ from a personal one? This research offers a method and a context for revealing one specific perception gap, and the ways in which this method could be applied to explore other examples of a perception gap poses interesting possibilities. Perception gaps, such as the one discussed in this research, are perhaps mostly invisible, made so by dominant patterns or power systems and problematic for people for whom discrepancy or tension is difficult and who would rather reconcile the difficulty as

easily as possible than expose it further, or for people who benefit from these patterns and power structures. Technology forces the body into modes of sensing and feeling, which re-enforce a system primed in favour of the seen over the felt – this research actively seeks to challenge this status quo. To re-instigate felt sensations and the empathetic exchanges that arise with them. To empower bodies to be somatically sensing in their encounters with technology. The methodology developed and used in this research, which combines technology and dance practices, offers possibilities beyond the creation of performance practices, for example, developed as perceptual tuning or training methods for cognitive and social science investigations.

An environment impacts directly on the health and well-being of the people who live and move within it, and, reciprocally, these people and their movements affect the environment in which they live. The human and non-human world is woven together as a relational meshwork, and technologies have become part of this 'weave'. Environments are perceived through the senses and, whilst humans are multimodal animals, vision is by far the most dominant of the senses and underlies much of human perceptual experience, and this pattern is perpetuated by technologies (and VR is currently the most extreme example of this). This research has applied a dance-led methodology for working with VR technology in developing a practice-based understanding of the technology and of different experiences of participation within it. This project connects to a long history of body-technology relations and to technology in performance, a very fertile ground for philosophical debate and research on technology and the post-human condition. Immersive XR technologies, specifically technologies of vision such as VR, binaural technologies of sound, and haptic technologies of touch, could be considered simply as tools for mediating or enhancing human perception in the moments of connection between body and machine; yet there are the possibilities for a more intrinsic sensory rewiring of the body, extending the possibilities and bounds of the human perceptual system from the inside out. With either potentiality, I advocate in this research for a livelier embodied understanding of and within these relations. Further study is warranted on this wider philosophical debate, which takes forward the valuable insights of this research project.

Human attention embeds in modes of perception and in processes of embodied construction through and as technologies. "[W]e have moved into an era of representation of the self through diverse virtual bodies, thereby expanding ourselves into many selves" (Broadhurst

and Machon 2012: 77) and in our participation, “we aid the gradual dissolution of the boundaries between the real and the virtual” (Broadhurst and Machon 2012: 77). The current COVID-19 pandemic has rapidly increased the use of (mostly visual) technologies (such as Zoom), and through this time, I have missed the physicality of a shared practice. I have found myself dreaming of a lost sensibility – in the forming and practice of a creative process. The shared physicality and felt engagement between bodies in a space has been lost to me. Moving forwards, I will engage in embodied ways with and without the mediation of technology, inviting movement scores for moving simultaneously ‘alone and together’ – not mediated by technology, but instead bringing in our imaginations to summon the physicality of a felt sensing of the other. A process of “recuperation of the incarnate, sensorial dimension of experience” (Abram 1997: 65) and, in a reciprocity, the “recuperation of the living landscape in which we are corporeally embedded” (Abram 1997: 65). As New York Times journalist Gia Kourlos writes, “If this pandemic is teaching us anything, it is that we need to return to our bodies" (Kourlos 2020).

> In a time when it seems we have little control, having agency over our bodies – and our internal world – is a kind of power. By engaging in a somatic experience, you come to realize that these practices are not just about creating flexible bodies, but flexible minds. (Kourlos 2021)

I return, in these final paragraphs, to re-consider the research questions – which centred on the notion of a perceptual gap, sensed between seeing and feeling, resulting in a shifting attention between the physical and the virtual. The practice of this research has enabled me to explore these ideas, in my own body and in the bodies of others. I have been able to make explicit the implicit modes of sensing dancers train and use in their practices, and to connect these modes of sensing with the issues that I have with VR technology. My position has flexed and changed in response to examining and critically reflecting on these issues. My embodied investigations and discoveries have complicated the notions of a binary opposition between the physical and the virtual. In the doing, a more nuanced understanding which complicates these ideas, surfaces and resonates within my moving, sensing body.

Reflecting on how the virtual acts on the body, I draw on Barad’s agential realism, a “posthumanist performative approach to understanding technoscientific and other naturalcultural practices that specifically acknowledges and takes account of matter’s

dynamism" (Barad 2007: 135). Barad wants to account for "the boundary-making practices by which the 'human' and its others are differently delineated and defined" (Barad 2007: 136), "[r]efusing the anthropocentrisms of humanist and antihumanist" (Barad 2007: 136) by "being accountable for the role we play in the differential constitution and the differential positioning of the human among other creatures (both living and non-living)" (Barad 2007: 136). Barad's notion of 'intra-action', in contrast to interaction "which presumes the prior existence of independent entities" (Barad 2007: 139), transcends all binary notions. It is through the "specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful" (Barad 2007: 139). My body and the VR technology, my eyes and my fingers, seeing and feeling, are intra-acting upon one another with a multitude of 'other' human and non-human, living and non-living, but lively, creatures. Through this research, these "(re)configurings of the world" (Barad 2007: 140), the "complex agential intra-actions of multiple material-discursive practices or apparatuses of bodily production" (Barad 2007: 140), have "come to matter" (Barad 2007: 140).

In combination with Barad's theories, I bring in the thoughts and sensibilities of a dancer, drawn from her practice of sensing in contact improvisation. Nancy Stark-Smith reflects on her embodied experiences of moving in the in-between-ness of the relationality of things -

> It is a place from which more directions are possible than anywhere else. I call this place the Gap. The more I improvise, the more I'm convinced that it is through the medium of these gaps – this momentary suspension of reference point – that comes the unexpected and much sought after 'original' material. It's 'original' because it comes from outside our usual frame of reference (Stark Smith 2003: 246).

She writes, "Being in a gap is like being in a fall before you touch bottom. You're suspended – in time as well as space" (Stark Smith 2003: 247). These moments are, as Stark-Smith describes, "one of the precious spots offered by improvisation" (Stark Smith 2003: 246). Stark-Smith's experience of this gap is not dissimilar to the one I have experienced, described, and questioned in this research. I find myself entangled in response to the discoveries I have made in the theoretical breaking down of binary distinctions between physical and virtual, and the complicatedness and nuances of my bodily sensing - as a dancer

being ‘in a fall’ between two points of sensory knowing. Both practice and theory draw on the entanglement and collaboration between material and virtual, rather than maintaining the gap or binary distinction. Cooper-Albright writes about Stark-Smith’s ‘gap’ as “a space in which to change our habitual responses” (Cooper Albright 2003: 259). “Moments that once were easily and automatically filled have become uneasily and consciously unfilled. By leaving them unfilled, I’m not only breaking a ‘momentum of being,’ a pattern of behaviour, but I’m bringing attention and charge to a moment that would have passed without remark” (Cooper Albright 2003: 258). The ‘gap’ is a “moment of possibility” (Cooper Albright 2003: 258), it is “a suspension of reference points in which new experiences become possible” (Cooper Albright 2003: 258). Through the participatory practice of this research, I have discovered that my experience of the perception gap between seeing and feeling in VR, initially felt as a tension in my sensing body, is differently nuanced in the experiences of others - the participants in the workshops, and the collaborators, dancers and participants in *Figuring* and *Soma*. Through processes of sharing and exploring these differences, this gap has become a space of possibility, for new ways of being, moving and sensing in and as a world, in which reality is both physical and virtual.

Bibliography

Abram, D. (1997) *The Spell of the Sensuous.* New York: Vintage Books.
Alston, A. and Welton, M. (eds.) (2017) *Theatre in the Dark: Shadow, Gloom and Blackout in Contemporary Theatre*: Bloomsbury.
Bacon, J. (2010) 'The Voice of Her Body: Somatic Practices as the Basis for Creative Research Methodology', *Journal of Dance and Somatic Practices,* 2(1).
Barad, K. (2007) *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* U.S.A.: Duke University Press.
Barad, K. (2012) 'On Touching - The Inhuman That Therefore I Am', *Differences: A Journal of Feminist Cultural Studies,* 25(5), pp. 206-223.
Batson, G. (2014) 'Intimate to Ultimate: The Meta-Kinesthetic Flow of Embodied Engagement', in Williamson, A., Batson, G., Whatley, S. & Weber, R. (eds.) *Dance, Somatics and Spiritualities: Contemporary Sacred Narratives*. Bristol, UK and Chicago, USA: Intellect.
Baudrillard, J. (1981) *Simulacra and Simulation.* France: Editions Galilee.
BeAnotherLab (2012) *The Machine to be Another*. Available at: http://beanotherlab.org/home/work/tmtba/.
Belisle, B. and Roquet, P. (2020) 'Guest Editors' Introduction: Virtual Reality: Immersion and Empathy', *Journal of Visual Culture,* 19(1).
Belova, O. (2006) 'The Event of Seeing: A Phenomenological Perspective on Visual Sense-Making', *Culture and Organization,* 12(2), pp. 93-107.
Benford, S. and Giannachi, G. (2011) *Performing Mixed Reality.* Massachusetts: MIT Press.
Bennett, J. (2010) *Vibrant Matter: A Political Ecology of Things.* Durham, N.C.; London: Duke University Press.
Biocca, F. (1997) 'The Cyborg's Dilemma: Progressive Embodiment in Virtual Environments', *Journal of Computer-Mediated Communication,* 3(2).
Birringer, J. (2012) 'Bodies of Colour/Media Skins. In: Intimacy Across Visceral and Digital Performance', in M., C. & R., Z. (eds.). London: Palgrave Studies in Performance and Technology. Palgrave Macmillan, pp. 143-158.
Bishop, C. (2006) *Participation.* Whitechapel and The MIT Press.
Boddington, G. and Bannerman, C. (2008) 'Sharing the Process: A Consideration of Inter-Authorship in the Performing Arts', *Research in Mathematics Education,* 15(2).
Bodker, S. 'When Second Wave HCI Meets Third Wave Challenges'. *Nordic Conference on Human-Computer-Interaction: Changing Roles*, pp. 1-8.
Braidotti, R. (2006) 'The Ethics of Becoming Imperceptible', in Boundas, C. (ed.) *Deleuze and Philosophy*, pp. pp. 133-159.
Braidotti, R. (2013) *The Posthuman.* Cambridge: Polity Press.
Braun, V. and Clarke, V. (2006) 'Using Thematic Analysis in Psychology', *Qualitative Research in Psychology,* 3:2, pp. 77-101.
Broadhurst, S. and Machon, J. (eds.) (2012) *Identity, Performance and Technology: Practices of Empowerment, Embodiment and Technicity*: Palgrave Macmillan.
Brown, C. (2006) 'Learning to dance with Angelfish: Choreographic Encounters between Virtuality and Reality', *Performance and Technology*: Palgrave Macmillan, pp. pp. 85-99.
Buckley, J. (2011) 'Believing in the (Analogico)-Digital', *Culture Machine,* 12.
Buckwater, M. (2010) *Composing While Dancing: An Improvisers Companion.* The University of Wisconsin Press.

Bull, M. (2006) 'Auditory', in Jones, C.A. (ed.) *Sensorium: Embodied Experience, Technology, and Contemporary Art*. Cambridge, Massachusetts: The MIT Press.
Calleja Shaw, B. (2020) 'Of Honey and Waxwood: Encountering Inter-Animacy through Phenomenology', in Sarco-Thomas, M. (ed.) *Thinking Touch in Partnering and Contact Improvisation: Philosophy, Pedagogy, Practice*. UK: Cambridge Scholars Publishing.
Capps, K. (2018). Available at: *https://www.citylab.com/life/2018/06/the-experience-is-virtual-the-terror-is-real/561941/*.
Care Collective, T. (2020) *The Care Manifesto: The Politics of Interdependence.* London and New York: Verso.
Cassani, B. (2019) 'The Politics of Participatory Choreographic Practice in Urban Public Space', *Choreographic Practices,* 10, pp. 75-90.
Cheng, L. P., Marwecki, S. and Baudisch, P. (2017) 'Mutual Human Actuation'.
Cho, S., Ku, J., Cho, Y. K., Kim, I. Y., Kang, Y. J., Jang, D. P. and Kim, S. I. (2014) 'Development of Virtual Reality Proprioceptive Rehabilitation System for Stroke Patients', *Computer Methods and Programs in Biomedicine,* 113(1), pp. 258-265.
Chvasta, M. (2005) 'Remembering Praxis: Performance in the digital age', *Text and Performance Quarterly,* 25(2), pp. 156-170.
Clark, A. (2007) 'Re-Inventing Ourselves: The Plasticity of Embodiment, Sensing, and Mind', *Journal of Medicine and Philosophy,* 32, pp. pp. 263-282.
Clarke, V. C. and Braun, V. (2015) 'Thematic Analysis', *Journal of Positive Psychology*.
Clifford, J. and Marcus, G. E. (1986) *Writing Culture: The Poetics and Politics of Ethnography.* Berkeley, Los Angeles, London: University of California Press.
Connor, M. O., Deeks, H. M., Dawn, E., Metatla, O., Roudaut, A., Glowacki, B. R., Sage, R., Tew, P., Wonnacott, M., Bates, P., Adrian, J. and Glowacki, D. R. (2018) 'Sampling Molecular Conformations and Dynamics in a Multi-User Virtual Reality Framework'. *Science Advances*.
Cooper Albright, A. (2003) 'Epilogue', in Cooper Albright, A. & Gere, D. (eds.) *Taken By Surprise: A Dance Improvisation Reader*. Connecticut: Wesleyan University Press.
Cortese, M. and Zeller, A. (2019) *Designing Safe Social VR: Using the Ideology of Sexual Consent to Make Social VR a Better Place*. Available at: https://immerse.news/designing-safer-social-vr-76f99f0be82e.
Curtis, F. (2019) 'Climate Change for the Experience Economy 'Olafur Elisasson: In Real Life'', *The Exhibition Review*.
Cutting, J. E. (2012) 'Gunnar Johansson, Events, and Biological Motion', in Johnson, K. & Shiffrar, M. (eds.) *People Watching: Social, Perceptual, and Neurophysiological Studies of Body Perception*: Oxford University Press.
Davies, C. (1998) 'OSMOSE: Notes on Being in Immersive Virtual Space', *Digital Creativity,* 9(2).
de la Bellacasa, M. P. (2017) *Matters of Care: Speculative Ethics in More Than Human Worlds.* University of Minnesota Press.
De Spain, K. (2014) *Landscape of the Now: A Topography of Movement Improvisation.* Oxford University Press.
Deleuze, G. (2001) 'Pure Immanence: Essays on A Life'. New York: Zone Books.
Denshire, S. (2014) 'On Auto-Ethnography', *Current Sociology Review,* 62, pp. pp. 831-850.
Diallo, L. 2020. *RE: Email to Lisa May Thomas.*
Dixon, S. (2007) *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation.* Cambridge, Massachusetts & London, England: Massachussetts Institute of Technology.

Dourish, P. (2004) *Where the Action Is: The Foundations of Embodied Interaction.* Massachusetts: MIT Press.
Drucker, J. (2011) 'Humanities Approaches to Interface Theory', *Culture Machine,* 12.
Dunne, J. and ZU-UK (2018) 'Good Night, Sleep Tight (Remix)', *International Journal of Performance Arts and Digital Media,* 14, pp. 215-223.
Eliasson, O. (ed.) (2007) *Models are Real*.
Ellis, P. (2016) 'Virtual Empathy" Does VR Have the Power to Make us Care More?', *Huffington Post*. Available at: https://www.huffingtonpost.co.uk/philip-ellis/virtual-reality-empathy_b_9234956.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAI4bMoHwdMDjIVbyJhsjEXjPpfVaVC1IOpmMnSbLoPxvi7Qmusb8zqdqSXd9oKPaxPMuy2_S7mA5q4LBBJPAsSK8ncUReK8KgFIMRRrph3BCwqUgYucr1rnaiM5RnJ0vvFZ_0LQCEzejraYXeovMWOS1OuJvoQIKMukCBszC5a6U.
Faria, R. R. A., Zuffo, M. K. and Zuffo, J. A. 'Improving spatial perception through sound field simulation in VR'. *VECIMS 2005 – IEEE International Conference on Virtual Environments, Human-Computer Interfaces, and Measurement Systems.* Giardini Naxos, Italy.
Forti, S. (2003) 'A Practice in Dance Improvisation', in Cooper Albright, A. & Gere, D. (eds.) *Taken By Surprise: A Dance Improvisation Reader*. Connecticut: Wesleyan University Press.
Le Corps Utopique, 1966. Directed by Foucault, M.
Fullman, E. 2015. The Long String Instrument. Sydney Festival.
Furness Jayne, C. (2017) *String Figures and How to Make Them.* New York: Dover Publications, Inc.
Giannachi, G. (2004) *Virtual Theatres: An Introduction.* Routledge.
Gibson, J. J. (1986) *The Ecological Approach to Visual Perception.* New York and London: Psychology Press, Taylor and Francis.
Grasse, V. (2019) 'MESH: The Ensemble City - Public rituals of togetherness', *Choreographic Practices,* 10(1), pp. 59-74.
Grau, O. (2003) *Virtual Art: From Illusion to Immersion.* The MIT Press.
Hamera, J. (2007) *Dancing Communities: Performance, Difference, and Connection in the Global City.* New York: Palgrave Macmillian.
Hanna, T. (1991) 'What is Somatics?', *Journal of Behavioural Optometry,* 2(2).
Hansen, M. B. N. (2006) *Bodies in Code: Interfaces with Digital Media.* Routledge. Taylor & Francis Group.
Haraway, D. J. (2006) 'Crittercam: Compounding Eyes in NatureCultures', *Postphenomenology: A Critical Companion to Ihde*: SUNY Press.
Haraway, D. J. (2016) *Staying With The Trouble.* Duke University Press.
Harris, T. (2019) 'Tech is 'Downgrading Humans.' It's time to Flight Back', *Wired*.
Hayles, K. N. (2017) *Unthought: The Power of the Cognitive Nonconscious. Chicago & London*: The University of Chicago Press.
Hayles, N. K. (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics.* Chicago and London: The University of Chicago Press.
Hill, S. (2013) '"An Invitation for Disaster" - Embracing the 'Double Failure' of Improvisation', *Critical Studies in Improvisation,* 9(2).
Ihde, D. (1990) 'Technology and the Lifeworld: From Garden to Earth'. Bloomington and Indianapolis: Indiana University Press.
Ingold, T. ID Crossing Borders Talk.
Ingold, T. (2011) *Being Alive: Essays on Movement, Knowledges and Description.* Routledge.

Ingold, T. (2013a) 'Dreaming of Dragons: On the Imagination of Real Life', *Journal of the Royal Anthropological Institute,* 19(4), pp. pp. 734-752.
Ingold, T. (2013b) *Making: Anthropology, Archaeology, Art and Architecture.* Routledge.
Ingold, T. (2016) *Lines.* Routledge Classics.
Janowski, M. and Ingold, T. (eds.) (2016) *Imagining Landscapes: Past, Present and Future*: Routledge.
Jones, C. A. (2006) *Sensorium: Embodied Experience, Technology and Contemporary Art.* The MIT Press.
Jones, S. 'My (Other) Other Collaborator: Philosophy Alongside Practice as Research in Performance'. *Beyond Application? Immanent Encounters between Philosophy and The Arts*, University of Surrey.
Júdová, M. and Boleslavsky, A. (2016) *Dust: A Virtual Reality* http://vrdust.org.uk/.
Kampe, T. 'Bodily Undoing Symposium'. *Bodily Undoing: Somatic Activism and Performing Cultures as Practices of Critique*, Bath Spa University.
Katan-Schmid, E. (2020) 'Playing with Virtual Realities: Navigating Immersion within Diverse Environments (Artist-Led Perspective)', *Body, Space & Technology,* 19(1), pp. 224-238.
Kester, G. (2013) 'Galatea's Gaze: Ethics, Spectacle and Participation'.
Kimmel, M. (2013) 'Intersubjectivity at Close Quarters: How Dancers of Tango Argentino Use Imagery for Interaction and Improvisation', *Cognitive Semiotics,* 4(1), pp. 76-124.
Knibbe, J., Jonas, S., Mathias, P. and Kasper, H. 'The Dream is Collapsing: The Experience of Exiting VR'. *CHI*, Montréal, QC, Canada.
Koteen, D. and Stark Smith, N. (2008) 'Caught Falling: The Confluence of Contact Improvisation, Nancy Stark Smith and Other Moving Ideas', Wesleyan University Press.
Kourlos, G. (2020) 'How We Use Our Bodies to Navigate a Pandemic', *New York Times*.
Kozel, S. (2007) *Closer: Performance, Technologies, Phenomenology.* Cambridge, MA and London: Massachusetts Institute of Technology.
LACMA (2017-18). Available at: *https://www.lacma.org/art/exhibition/alejandro-g-inarritu-carne-y-arena-virtually-present-physically-invisible*.
Lahti, M. (2003) 'As We Become Machines: Corporealized Pleasures in Video Games', in Wolf, J.P.M. & Person, B. (eds.) *The Video Game Theory Reader*. London and New York: Routledge.
Lanier, J. (2001) 'Virtually There', *Scientific American*.
Lanier, J. (2017) *Dawn of the New Everything: Encounters with Reality and Virtual Reality.*
Leder, D. (1990) *The Absent Body.* University of Chicago Press.
Legarnisson, E. (2018). Available at: https://elynelegarnisson.myportfolio.com/unbalance-at-interactivearchitecturelab.
Leigh Foster, S. (2003) 'Improvisation in Dance and Mind', in Cooper Albright, A. & Gere, D. (eds.) *Taken by Surprise: A Dance Improvisation Reader*. Connecticut: Wesleyan University Press.
Little, N. (2014) 'Restructuring the Self-Sensing: Attention Training in Contact Improvisation', *Journal of Dance and Somatic Practices,* 6(2).
Little, N. (2016) 'Enminded Performance: Dancing with a Horse': Lexington Books.
Little, N. and Dumit, J. (2020) 'Articulating Presence: Attention is Tactile', in Sarco-Thomas, M. (ed.) *Thinking Touch in Partnering and Contact Improvisation: Philosophy, Pedagogy, Practice*. UK: Cambridge Scholars Publishing.
Loke, L. and Schiphorst, T. (2018) 'The Somatic Turn in Human-Computer Interaction', *Interactions,* XXV(5).

Lopes Ramos, J. D.-H., Joseph Maravala, Persis Jadé Simon, Bart (2020) 'The Post-Immersive Manifesto', *International Journal of Performance Arts and Digital Media*.
Lécuyer, A. (2009) 'Simulating Haptic Feedback Using Vision: a Survey of Research and Applications of "Pseudo-Haptic Feedback"', *Presence,* 18(1), pp. pp. 39-53.
Machon, J. (2001) '(Syn)aesthetics and Disturbance - A Preliminary Overview', *Body, Space & Technology,* 1(2).
Machon, J. (2009) *(Syn)aesthetics – Redefining Visceral Performance* Palgrave Macmillan.
Machon, J. (2013) '(Syn)aesthetics and Immersive Theatre: Embodied Beholding in Lundahl & Seitl's 'Rotating in a Room of Images'', in Shaughnessy, N. (ed.) *Affective Performance and Cognitive Science: Body, Brain and Being*. London, New Delhi, New York, Sydney: Bloomsbury.
Machon, J. (2016) 'Watching, Attending, *Sense*-making: Spectatorship in Immersive Theatre', *Journal of Contemporary Drama in English,* 4(1).
Madary, M. and Metzinger, T. K. (2016) 'Real Virtuality: A Code for Ethical Conduct', *Frontiers in Robotics and AI*.
Madison, S. (2005) *Critical Ethnography: Method, Ethics, and Performance.* California: Sage Publications, Inc.
Manning, E. (2007) *Politics of Touch: Sense, Movement, Sovereignty.* Minneapolis: University of Minnesota Press.
Marchant, J. (2007) *Cure: A Journey into the Science of Mind and Body.* Edinburgh: Canogate Books.
Marks, L. U. (2000) *The Skin of the Film.*
Marks, L. U. (2002) *Touch: Sensuous Theory and Multisensory Media.* Minneapolis and London: University of Minnesota Press.
Massumi, B. (2002) *Movement, Affect, Sensation: Parables for the Virtual.* Durham & London: Duke University Press.
McCarthy, J. and Wright, P. (2007) *Technology as Experience.* MIT Press.
McEwan, B. 2020. *RE: Email to Lisa May Thomas.*
Merleau-Ponty, M. (1962) *Phenomenology of Perception.* Translated by: Smith, C.: Routledge & Kegan Paul.
Merleau-Ponty, M. (1968) *The Visible and the Invisible.* Translated by: Lingis, A. US: Northwestern University Press.
Middleton, P. and Spinney, J. (2016) *Notes on Blindness*. Available at: http://www.notesonblindness.co.uk/.
Morris, N. J. (2011) 'Night Walking: Darkness and Sensory Perception in a Night-Time Landscape Installation', *Cultural Geographies, Sage Publications,* 18(3), pp. pp. 315-342.
Murray, C. D. and Sixsmith, J. (1999) 'The Corporeal Body in Virtual Reality', *Ethos,* 27(3), pp. 315-343.
O'Connor, M. B., Bennie, S. J., Deeks, H. M., Jamieson-Binnie, A., Jones, A. J., Shannon, R. j., Walters, R., Mitchell, T. J., Mullholland, A. J. and Glowacki, D. R. (2019) 'Interactive Molecular Dynamics in Virtual Reality from Quantum Chemistry to Drug Binding: An Open-Source Multi-Person Framework', *The Journal of Chemical Physics,* 150(22).
Obi (2019) *Oriented Particle Physics for Unity*.
Pallasmaa, J. (2012) *The Eyes of The Skin.* U.K.: John Wiley & Sons Ltd.
Pallasmaa, J. (2017) 'Embodied and Existential Wisdom in Architecture: The Thinking Hand', *Body and Society,* 23(1), pp. pp. 96-111.

Parisi, D. (2018) *Archaeologies of Touch: Interfacing with Haptics from Electricity to Computing.* University of Minnesota Press.
Participant 2017a. *RE: Ways of Seeing Participant Email to Lisa May Thomas*.
Participant 2017b. Ways of Seeing Workshops. *In:* Thomas, L. (ed.) *Bodily Undoing Symposium.* Bath Spa University.
Participant 2018a. *RE: Digital Echoes Participant Email to Lisa May Thomas.*
Participant 2018b. Figuring Prompted Group Discussions. *In:* Thomas, L.M., Amarasuriya, T. & Thomas, P. (eds.). University of Bristol.
Participant 2018c. Mark-Making in The Felt Sense Workshops. *In:* Thomas, L.M. (ed.). Knowle West Media Centre.
Participant 2018d. The Felt Sense Workshops. *In:* Thomas, L.M. (ed.). Knowle West Media Centre.
Participant 2018-19. Figuring One-To-One Interviews. *In:* Thomas, L.M. (ed.). University of Bristol.
Participant, S. 2019a. Soma Focus Group with Dance and Theatre Practitioners. *In:* Thomas, L.M. (ed.).
Participant, S. 2019b. Soma Focus Group with Visually-Impaired Participants. *In:* Thomas, L.M. (ed.).
Paterson, M. (2007) *The Senses of Touch: Haptics, Affects and Technologies* Berg, imprint of Oxford International Publishers Ltd.
Paul, C. (2003) 'Digital Art'. London, UK: Thames & Hudson Ltd., pp. pp. 125-132.
Paxton, S. (2015) 'Why Standing?', *Contact Quarterly,* Winter-Spring.
Popat, S. (2016) 'Missing in Action: Embodied Experience and Virtual Reality', *Theatre Journal,* 68(3), pp. pp. 357-378.
Popat, S. (2017) 'Bodily Extensions and Performance', *International Journal of Performance Arts and Digital Media,* 13(2), pp. 101-104.
Pusch, A. (2008) *Visuo-Proprioceptive Conflicts of the Hand for 3D User Interaction in Augmented Reality.*
Pusch, A. and Lecuyer, A. 'Pseudo-Haptics: From the Theoretical Foundations to Practical System Design Guidelines'. *ICMI*, Alicante, Spain.
Sacks, O. (1985) *The Man Who Mistook His Wife for a Hat and Other Clinical tales.* Gerald Duckworth.
Saker, M. and Frith, J. (2018) 'From Hybrid Space to Dislocated Space: Mobile Virtual Reality and a Third Stage of Mobile Media Theory', *New Media & Society,* 21(1), pp. pp. 214-228.
Saker, M. and Frith, J. (2020) 'Coextensive Space: Virtual Reality and the Developing Relationship between the Body, the Digital and Physical space', *Media, Culture & Society,* 42(7-8), pp. pp. 1427-1442.
Sanchez-Vives, M. and Slater, M. (2005) 'From Presence to Consciousness through Virtual Reality', *Nature,* Volume 6, pp. 332-339.
Schiphorst, T., Loke, L. and Höök, K. (2020) 'Designing for Sensory Appreciation: Cultivating Somatic Approaches to Experience Design'. *CHI*.
Sheets-Johnston, M. (2009) *The Corporeal Turn: An Interdisciplinary Reader.* Imprint Academic.
Slater, M. (2009) 'Place Illusion and Plausibility can Lead to Realistic Behaviour in Immersive Virtual Environments', *Philosophical Transactions of the Royal Society*, pp. 3549-3557.
Slater, M. (2018) 'Immersion and the Illusion of Presence in Virtual Reality', *British Journal of Psychology,* (109), pp. 431-433.

Slater, M. and Sanchez-Vives, M. V. (2016) 'Enhancing Our Lives with Immersive Virtual Reality', *Frontiers in Robotics and AI,* 3(December), pp. 1-47.
Slater, M., Steed, A., McCarthy, J. and Marinelli, F. (1998) 'The Virtual Ante-Room: Assessing Presence through Expectation and Surprise'.
Slater, M. and Usoh, M. (1994) 'Body Centred Interaction in Immersive Virtual Environments', *Artificial life and virtual reality,* 1, pp. 1-22.
Slater, M. G.-L., Cristina Haggard, Patrick Vinkers, Charlotte Gregory-Clarke, Rebecca Jelley, Steve Watson, Zillah Breen, Graham Schwarz, RazSteptoe, William Szostak, Dalila Halan, Shivashankar Fox, Deborah Silver, Jeremy (2020) 'The Ethics of Realism in Virtual and Augmented Reality', *Frontiers in Virtual Reality*.
Squidsoup (2018) *Wave*. Available at: https://www.squidsoup.org/portfolio/wave/.
Stark Smith, N. (2003) 'Life Scores', in Cooper Albright, A. & Gere, D. (eds.) *Taken by Surprise*. Connecticut: Wesleyan University Press.
Sutherland, I. E. 'The Ultimate Display'. *Information Processing Techniques*. *IFIP Congress*, 506-508.
Switzer, R. (1997) 'Over-Writing the body: Virtual Reality and Cartesian Metaphysics', *Philosophy Today,* 41(4).
Thiriot, A.-G. 2020. *RE: Email Communication to Lisa May Thomas.*
Thomas, H. 2019a. *RE: Email Correspondence to Lisa May Thomas*.
Bringing Together Multi-Person Virtual Reality Technology, Dance Practice and Visual Impairment, 2019b. Directed by Thomas, L. M.
Tsay, C.-J. (2013) 'Sight Over Sound in the Judgment of Music Performance', *PNAS,* 110(36), pp. 14580-14585.
Tubb, R. (2012) *Wablet*. Available at: https://code.soundsoftware.ac.uk/projects/wablet.
Turkle, S. (2003) 'Technology and Human Vulnerability. A conversation with MIT's Sherry Turkle', *Harvard Business Review,* 81(9), pp. 43-50.
Turkle, S. (2011) *Alone Together: Why We Expect More from Technology and Less from Each Other.* Basic Books. A Member of the Perseus Books Group.
Varez, A. 2020. *RE: Email Communication to Lisa May Thomas.*
Voparil, C. and Giodano, J. (2015) 'Pragmatism and the Somatic Turn: Shusterman's Somaesthetics and Beyond', *Metaphilosophy,* 46(1).
Whatley, S. (2015) 'Motion Capture and The Dancer', in Whatley, S., Garrett Brown, N. & Alexander, K. (eds.) *Attending to Movement: Somatic Perspectives on Living in this World*. UK: Triarchy Press.
Wilson, A. D. and Golonka, S. (2013) 'Embodied Cognition is Not What You Think it is', *Frontiers in Psychology,* 4(58).
Wilson, H. R. (2020) 'New Ways of Seeing, Feeling, Being: Intimate Encounters in Virtual Reality Performance', *International Journal of Performance Art and Digital Media*.
Yee, N. and Bailenson, J. (2007) 'The Proteus Effect: The Effect of Transformed Self-Representation on Behaviour', *Human Communication Research,* 33, pp. pp. 271-290.
Zaporah, R. (2003) 'A Body with a Mind of Its Own', in Cooper Albright, A. & Gere, D. (eds.) *Taken by Surprise: A Dance Improvisation Reader*. Connecticut: Wesleyan University Press.

List of Abbreviations

HCI – Human-Computer-Interaction
HMD – Head-Mounted Display (also referred to as VR headset)
IRL – Intangible Realities Laboratory (UoB)
MRP – Mixed Reality Performance
SF – String Figures
TFS – The Felt Sense workshops
UoB – University of Bristol
VR – Virtual Reality Technology
VE – the Virtual Environment of VR
WOS – Ways of Seeing workshops

Appendix 1: Timeline of Activity (January 2017 – May 2020) and Credits

January 2017: Barbican seed week
Led by Glowacki Group (University of Bristol)
Dr Gemma Anderson (artist)
Dancers: Isabel Cressy, Fernanda Munoz-Newsome, Anne-Gaëlle Thiriot

March 2017: Arnolfini residency and Dancer Labs (Bristol)
Thanks to Phil Owen, Arnolfini
Led by Lisa May Thomas
Dancers who participated in the dancer labs: Isabel Cressy, Verena Schneider, Stephanie Scheubeck, Emma Louvelle, Wina Lewis, Abi Price, Tim Lo, Ana Manuela Jara, Silvia Carderelli-Gronau, and Helen Kirby
Dancers involved in sharing performance: Fernanda Munoz-Newsome, Isabel Cressy, Silvia Carderelli-Gronau, and Ana Manuela Jara
VR: Glowacki Group (University of Bristol), Alex Jones (sound)
Katherine Hall (assisting interviews for dancer labs)
Elaine Robinson and Sarah Corbett (artists)

March 2017: Science Museum Lates VR event (London)
Led by Glowacki Group (University of Bristol) and Lisa May Thomas
Dancers: Fernandez Munoz-Newsome, Verena Schneider

April-May 2017: Bath Spa University residency and student placement leading into *The Edge* performance event, University of Bath (Bath)
Led by Lisa May Thomas
Bath Spa MA students: Stephanie, Silvia, Manu
Bath Spa BA students: Xavier, Sarah
Technical collaborators: Becca Rose (wearable technology costumes), Tom Mitchell (sound)

July 2017: *We The Curious* public installation
Interactive Scientific Ltd.

September 2017: *Ways of Seeing* workshop sessions at *Bodily Undoing* symposium at Bath Spa University
Thanks to Thomas Kampe (Bath Spa University)
Led by Lisa May Thomas
VR (technical support): Alex Jones (sound), Dr Balazs Hornung (VR)

September 2017: 2x explorative string figure sessions at Pervasive Media Studio with Becca Rose (Bristol)

January 2018: 'Playing with Virtual Realities' Symposium (Berlin)

February 2018: 2x explorative string figure sessions at Pervasive Media Studio with Becca Rose (Bristol)

April 2018: Bath Spa placement with BA students
(including 2x test sessions for *The Felt Sense* workshops)
Led by Lisa May Thomas
Bath Spa BA students: HJ, Ayanna, Meg
VR (technical support): Mike O'Connor

April 2018: *Digital Echoes* symposium session at Coventry University
Thanks to Scott deLahunta, Hetty Blades, Rosemary Cisneros and Lily Hayward-Smith
VR: Alex Jones and David Glowacki

May 2018: Knowle West Media Centre residency, public workshop and *The Felt Sense* workshop sessions
Thanks to Martha King, Knowle West Media Centre
Led by Lisa May Thomas
VR (technical support): Helen Deeks (VR), Alex Jones (sound)
HCI process and analysis support: Oussama Metatla
Adam D.J. Laity (filming), Silvia Carderelli-Gronau (filming), Emma Hughes (production/photography)

Public interactive installation at Modern Art Oxford with David Glowacki (2018)

July and September 2018 (3 weeks) UoB Wickham Theatre Figuring creative process, dancer's workshops (August) and prototype sharing (September)

October 2018 – January 2019: 121 Figuring interviews take place (with interviewer Lisa May Thomas)

October 2018: VR and CI workshop at the Bristol National CI Jam
Led by Lisa May Thomas
VR (technical support): Mark Wonnacott, Alex Jones

November 2018: PM Studio talk (Figuring) Led by Lisa May Thomas, with Emma Hughes, Alex Jones and Mark Wonnacott

March 2019: talk and VR trio workshop at Creative Informatics, University of Edinburgh, Led by Lisa May Thomas
VR (technical support): Alex Binne, Dr Stephanie Hare

Jan-July 2019: with Holly Thomas and Ute Leonards at UoB, Brigstow Ideas Exchange

May 2019: Bristol Old Vic residency #1 for *Soma*

July-August 2019: 3-days redevelopment and testing at Wickham Theatre (University of Bristol) for *Soma*
VR: Clarice Hilton and *All Seeing Eye*
Dancers: Laila Diallo, Holly Thomas and Silvia Carderelli-Gronau

September 2019: Bristol Old Vic residency #2 for *Soma*

November 2019: Lisa May Thomas participates in *QuestLab* at Studio Wayne McGregor

February 2020: Lisa May Thomas delivers talk for Somatics, Pain and Technology Network, Coventry University

March 2020: *Soma* Kaleider performance event Exeter x 6 performances

May 2020: cancelled dates for *Soma* at Bloomsbury Theatre (London) – re-scheduled for 2021-2022

***Figuring* team (2018-2019)**
Dancers: Bryn Thomas, Ben McEwan, Anne-Gaëlle Thiriot, Fernanda Munoz-Newsome, Will Dickie, Ania Varez and Laila Diallo
D. Glowacki, technical lead (supported the project through funding and technical kit and expertise)
Adam Laity, documentation and cinematography (filmed and edited the teaser trailer and *Figuring* journey)
Alex Jones, sound technology (developing sonification in the VE),
Tom Mitchell sound technology (developing sonification in the VE)
Joseph Hyde sound technology (developing the sound composition)
Luke Woodbury (developing the speakers for the *residue* environment)
Becca Rose, artist and designer (supported the project through material play and design)
Mark Wonnacott (VE design and aesthetics)
Mike O'Connor (VE design and interaction)
Helen Deeks (scientific adviser on HCI processes)
Stephen Ingram (scientific adviser for VR systems)
Philippa Thomas (designer for *Figuring residue* environment)
Tanuja Amarasuriya (dramaturge support)
Silvia Carderelli-Gronau (additional studio documentation support – filming and stills)
Emma Hughes, VR creative producer
Martha King, creative producer
Funders: Arts Council England, University of Bristol, Watershed, UWE, Pervasive Media Studio, Interactive Scientific, Bath Spa University, The Edge, and Bristol VR Lab. Further funding through D. Glowacki from CHAMPS, Leverhulme Trust, EPSRC, and The Royal Society.

***Soma team* (2019-2020)**
Dancers: Bryn Thomas, Ben McEwan, Anne-Gaëlle Thiriot, Fernanda Munoz-Newsome, Will Dickie, Ania Varez and Laila Diallo
Clarice Hilton (VR design and aesthetics)
All Seeing Eye (Adam Child, Ollie Lindsey, Robin North) (VR interaction and networking)
Jay Kerry (production manager for events and lighting design for Soma *residue*)
Holly Thomas (Visually impaired dancer)
Adam D.J. Laity (cinematography and editor for Soma teaser trailer)
Jonathan Eve (camera and sound editor for Soma teaser trailer)
Leticia Valverdes (photographer for Soma)
Silvia Carderelli-Gronau (additional studio documentation support – filming and stills)
Funders: Arts Council England, University of Bristol, The Brigstow Institute, UWE, Pervasive Media Studio, Bristol Old Vic, Studio Wayne McGregor, Theatre Bristol
Board members for May Productions Ltd: Verity Macintosh, Tom Morris, Suneeta Sellers, Lucie Spurr, and Chris Lewis-Smith

Brigstow Ideas Exchange team (2019)
Razaka Firmager (lighting, camera and editing, Brigstow ideas exchange project)
Holly Thomas (visually impaired dancer-collaborator, Brigstow ideas exchange project)
Ute Leonards (vision specialist, University of Bristol, Brigstow ideas exchange project)
VR support and technology: D. Glowacki, Mike O'Connor, Mark Wonnacott, Clarice Hilton, All Seeing Eye

Appendix 2: Workshop Tasks Descriptors and Sequencing

1. ***Ways of Seeing*** **workshops at the Bodily Undoing Symposium, Bath Spa University, September 2017**

Task 1.
Explore the space with your eyes:
I want you to start by taking 5 mins to explore the space you see – visually – with your eyes –
Taking in the space, and each other, and the objects in the space, also use this time to warm through your body, moving through the space, coming to rest in stillness in some moments always attending to what you are seeing keep your eyes open the whole time
Noticing colour, light and dark, shade, shape, texture, inside and outside, boundaries
Feed the space to your eyes

Task 2.
Sitting together to sense the space in the dark with eyes open:
I am now going to turn off the lights and so I invite you to find a place to rest – to sit or stand – but keeping the eyes open
We will spend two minutes together in this darkness and silence
Sitting together
Sensing the space together

Task 3.
In a blindfold and with a partner to support you, explore the space through touch, 'see' the space with your body:
I would like you to find a partner in the dark – there are 6 people so, 3 pairs – find each other and sit with each other
Allocate blindfolds to each two
Without speaking, decide who is going into the blindfold first and once the blindfolds are on I invite the blindfold wearer to explore the space – to see the space through touch for 5 minutes
The non-blindfold wearer is there to support, to guide if needed, to keep safe and to witness the blindfold wearer exploring the space – please guide them away from the lighthouse cameras, but allow them to pick up the headsets and controllers if they wish, this journey is led by the blindfold wearer and supported and witnessed by their partner
Touch will most likely come into this, and so please be clear on this touch as a guiding or supporting touch
These roles are to be negotiated between you, ideally not speaking, but if you have to talk it's fine of course

Task 4.
The VR headsets are placed over the blindfolds, sense and explore their weight and materiality:
Please find a place of resting with your partner
The non-blindfolded person will now help to put on the VR headset on top of the blindfold explore the weight of this headset on your head and also the wires attached to the headset which go to the backs of the laptops, giving you only so much reign, if you feel the pull of the wire, it means you need to stop moving in that direction

Task 5.
The blindfold is taken out from under the headset, explore the virtual environment:
Pull the blindfold out from under the VR headset
explore the VE – move to the edges, find the ground
explore and notice what is moving in the VE and how it moves
add controllers to point to and move the virtual objects – explore proximity
your partner is there to witness you and to keep you safe – and again touch can be used to guide and to offer support
please negotiate this with your partner, again ideally not speaking

Switch over roles with your partner:
Take a minute to remove the headset and place back to the sides of the space
You are going to switch over with the blindfold on to the other person – supply new blindfolds
Allow a little moment to settle before the journey for the second person begins

Task 6.
Reflection, 're-seeing' the space:
take a moment to look and move around the space as you did at the start of the workshop before coming in to form a circle, notice any differences compared to the start of the workshop

Group open discussion
Participants were invited to share their reflections and responses to the workshop experience and in which they were asked to describe how they felt, sensed and moved – the physical, somatic, and sensory qualities of the body, the other bodies and the environments.

2. The Felt Sense workshops at Knowle West Media Centre, July 2018

Task 1.
Exploration with physical 'ball-shaped' objects:
Eyes closed, anticipation of touch
Eyes closed, receiving touch
Eyes closed, handling and passing the ball
Eyes closed, absence of touch
Eyes open with visual exploration with more handling and passing – throwing, rolling, be creative
Notice how the object feels before you receive it, when you hold it, and after you have passed it to someone else
What are the sensations?

Task 2.
Imaginative exploration of 'ball-shaped' objects:
Imagine a ball-like object between your hands
Take some time to imagine it
Move, rotate, expand/contract your ball
Try closing your eyes for some of the time
Notice any differences to how you are sensing or feeling the ball with your eyes open and your eyes closed
Pass or share your ball with each other
Notice how does this imagined object feel?
What are the sensations?

Task 3.
Exploration of 'ball-shaped' objects in the virtual environment through sound – moving the sonified balls using the VR controllers:
We are going to play you the sound of a virtual ball
The sound you will hear is dynamic and it represents the movement energy of this virtual object inside the VR system
But you won't be able to see it just hear it – if you looked though the headsets you would see this ball but we want you to just hear it
We are going to give you a controller and with this controller you can move the ball in the virtual space which will then affect the sounds you are hearing, in real-time
Notice, what sort of sensations of this virtual object you get from the sound and your unseen interactions with it through the controller?

Task 4.
Exploration of 'ball-shaped' objects in the visual, virtual environment – within the VR headsets and using the VR controllers, no sound:
Acknowledge each other in the VE, waving and bowing in
Holding the ball still
Pinging the ball
Rotating the ball
Passing the ball
Placing the ball over your head, and then over someone else's head
Notice how the virtual objects feel, or how you sense them

Task 5.
Exploration of 'ball-shaped' objects in the visual, virtual environment with sound:
Notice any differences with the sound in terms of how the virtual objects feel, or how you sense them

Task 6.
Returning to imaginative exploration, a reimagining of 'ball-shaped' objects:
Re-finding an imagined ball
Notice how does this imagined object feel?
What are the sensations?
Notice any differences to your initial imagined ball
Ending – squish the ball until your hands are touching and then please place your hands on your belly and take a breath

Group discussion questions:

- *Please could you each talk very briefly about your experience?*
- *Describe your final imagined session, describe what you did during the final session?*
- *How did the last imagined task feel differently to the first?*
- *How did the sound affect your experience?*
- *Does anyone have any other further comments, questions, comments, etc.*